

NASA

Energy
A Continuing
Bibliography
with Indexes

NASA SP-7043(20)
January 1979

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IAA (A-10000 Series)

A78-43303 – A78-53918

STAR (N-10000 Series)

N78-28043 – N78-34034

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ENERGY

A Continuing Bibliography

With Indexes

Issue 20

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced from October 1 through December 31, 1978 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA)*

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INTRODUCTION

This issue of *Energy A Continuing Bibliography with Indexes* (NASA SP-7043(20)) lists 1250 reports, journal articles, and other documents announced between October 1, 1978 and December 31, 1978 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of this continuing bibliography was published in May 1974 and succeeding issues are published quarterly.

The coverage includes regional, national and international energy systems; research and development on fuels and other sources of energy; energy conversion, transport, transmission, distribution and storage, with special emphasis on use of hydrogen and of solar energy. Also included are methods of locating or using new energy resources. Of special interest is energy for heating, lighting, for powering aircraft, surface vehicles, or other machinery.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries* in that order. The citation, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR* including the original accession numbers from the respective announcement journals. This procedure, which saves time and money accounts for the slight variation in citation appearances.

Five indexes -- subject, personal author, corporate source, contract number, and report number -- are included. The indexes are of the cumulating type throughout the year, with the fourth quarterly publication containing abstracts for the fourth quarter and index references for the four quarterly publications.

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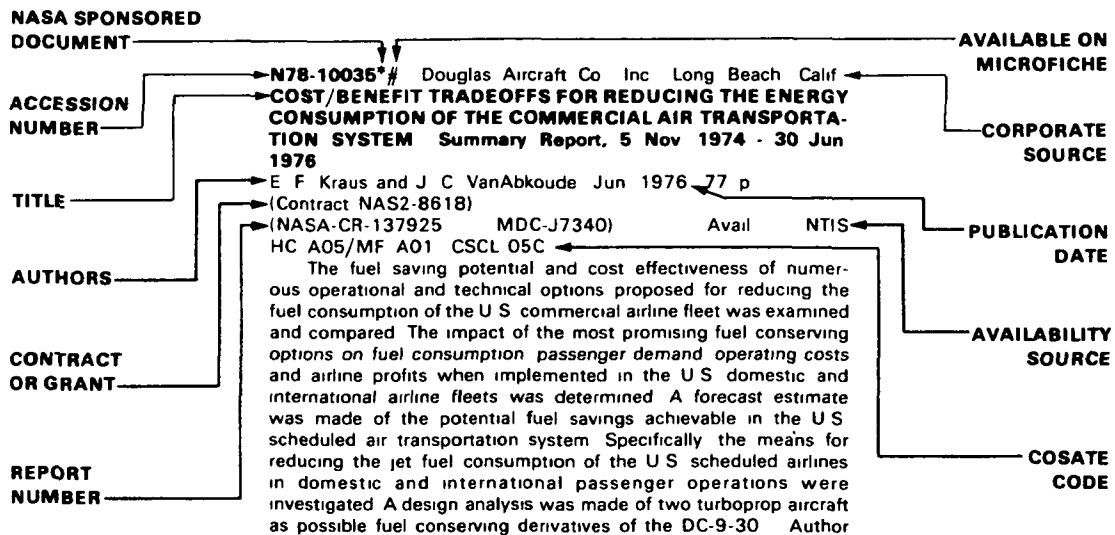
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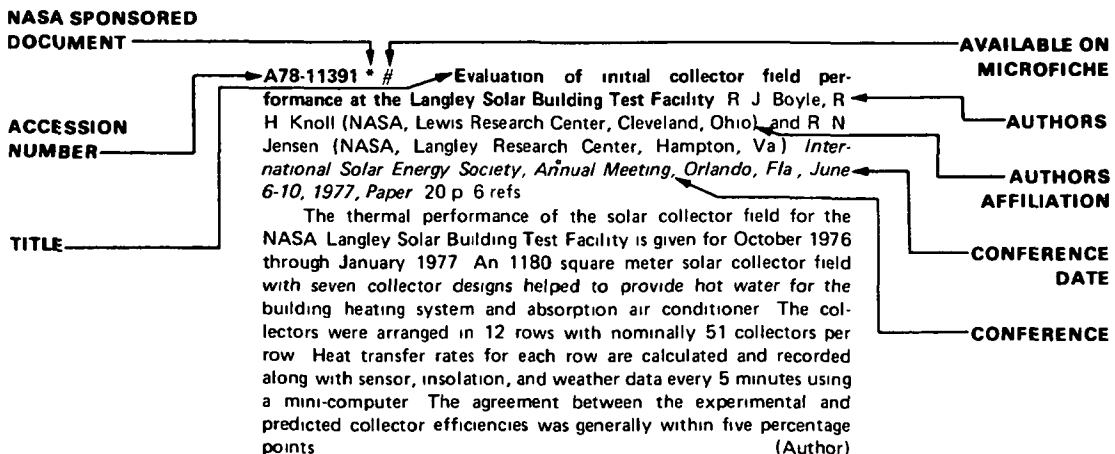
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TYPICAL CITATION AND ABSTRACT FROM IAA



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3. Pipeline corrosion, volume 1. Citations from the engineering index data base p0557 N78-29230
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6. Synthetic fuels from municipal, industrial, and agricultural wastes. Citations from the American Petroleum Waste Institute data base p0558 N78-29267
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JANUARY 1979

IAA ENTRIES

A78-43325 # Detection of heat loss from buildings through aerial thermography - Applications and methodology G R Lawrence (Ontario Centre for Remote Sensing, Toronto, Canada) In *Canadian Symposium on Remote Sensing, 4th, Quebec, Canada, May 16-18, 1977, Proceedings* Ottawa, Canadian Aeronautics and Space Institute, 1977, p 220-226 5 refs

The article discusses the application of aerial thermography for the identification of building heat losses. The following necessary conditions are identified: (1) the overflight should begin 3 hours after sunset or 1 hour after the expected nighttime low, (2) daytime temperature should be about 5 C and nighttime temperature should be about 3 C, (3) the air should be relatively calm, (4) the sky should be relatively clear, (5) there should not be a temperature inversion between the ground and the aircraft, (6) the dew point should be at least 3 C, and (7) the aircraft should be flown at an altitude in the 360-540 m range. Building heat loss is related to the apparent roof-top temperature sensed by the scanner. This temperature is translated into grey tones on the film. Information gathered by field checking has indicated that the technique yields reasonably accurate measurements of building heat loss. S C S

A78-43357 * # Planning a new era in air transport efficiency J J Kramer (NASA, Office of Aeronautics and Space Technology, Washington, D.C.) *Astronautics and Aeronautics*, vol 16, July-Aug 1978, p 26-28

The current status of the NASA Aircraft Energy Efficiency (ACEE) program is briefly reviewed with reference to CTOL aircraft. Attention is given to four basic technologies: turboprop, advanced aerodynamics and active controls, laminar flow control, and composites. B J

A78-43358 * # CTOL concepts and technology development D W Conner (NASA, Langley Research Center, Systems Analysis Branch, Hampton, Va.) *Astronautics and Aeronautics*, vol 16, July-Aug 1978, p 29-37 11 refs.

Various developments in the Aircraft Energy Efficiency (ACEE) program are discussed. Terminal-area operations are considered with emphasis on the Terminal Configured Vehicle program. Consideration is also given to aircraft systems studies and economics (including noise reduction programs), coal-derived fuels for aviation systems (including LH2-fueled aircraft), and transport-aircraft concepts (including laminar flow control). B J

A78-43359 * # Airframes and aerodynamics R W Leonard (NASA, Langley Research Center, Hampton, Va.) *Astronautics and Aeronautics*, vol 16, July-Aug 1978, p 38-46

The first part of the paper discusses the Energy Efficient Transport program of the Aircraft Energy Efficiency (ACEE) program, giving attention to the development of active aerodynamics

and active controls. The second part of the paper deals with two other portions of the ACEE program: Composite Primary Structures and Laminar Flow Control. B J

A78-43360 * # Propulsion D L Nored (NASA, Lewis Research Center, Energy Conservative Engines Office, Cleveland, Ohio) *Astronautics and Aeronautics*, vol 16, July-Aug 1978, p 47-54, 119 14 refs

NASA aims at developing propulsion technology to reduce the fuel consumption of present engines by 5%, that of new engines of the late 1980s by at least 12%, and that of an advanced early 1990s turboprop by an additional 15%. This paper reviews three separate NASA programs which take up these aims. They are, respectively, Engine Component Improvement, Energy Efficient Engine, and Advanced Turboprops. B J

A78-43388 Solar energy conversion using semiconducting photoanodes W A Gerrard and L M Rouse (Materials and Energy Research Centre, Teheran, Iran) (*American Vacuum Society and Institute of Electrical and Electronics Engineers, Symposium on Electron, Ion, and Photon Beam Technology, 14th, Palo Alto, Calif., May 25-27, 1977*) *Journal of Vacuum Science and Technology*, vol 15, May-June 1978, p 1155-1165 133 refs

The application of photoelectrochemical devices for solar energy conversion is considered. Problems associated with performance degradation when illuminated in an aqueous environment have been overcome by the addition of stabilizing redox ions to the electrolyte. In such devices conversion efficiency is a function of the Schottky barrier at the interface, the semiconductor bandgap and affinity, and the electrolyte redox level. Conversion efficiencies of 7-9% have been achieved. S C S

A78-43402 The reduction of nitrogen oxide emission in oil-burning installations (Stickoxid-Emissionsverringierung bei Ölfeuerungen). M Buzina, E Petro (Gebr. Sulzer AG, Winterthur, Switzerland), and H J Janssen (Servico AG, Langnau, Switzerland) *Brennstoff-Wärme-Kraft*, vol 30, June 1978, p 255-257. In German

A description is presented of an investigation which was conducted in connection with the further development of an industrial burner. Heavy and very light fuel oil fractions were used in the investigation. The burner design with respect to air and flue gas supply makes a variation of the operational conditions possible. Changes in the operational conditions were found to have a pronounced effect on the formation of nitrogen oxide. Reactions occurring under four different sets of operational conditions were investigated. It was found that the process of air and flue gas mixing, the injection location, and the entrance velocity of the gaseous mixture in the combustion chamber are important factors which determine the characteristics of the combustion process. The conditions for a minimization of nitrogen oxide formation are discussed. G.R

A78-43403 Coal processing technology Volume 3 New York, American Institute of Chemical Engineers, 1977 200 p \$20

Clean fuels from coal are considered along with uses for fluidized bed coal combustion, coal-fired MHD power generation, the environmental influence of coal liquefaction, presulfiding coal liquid hydrodesulfurization catalysts, removing micron size particles from coal liquids, the evaluation of coal carbonization processes, alternatives to stack-gas scrubbing, effluents from Synthene gasification of lignite, pressurized feed for coal gasification, purification processes for coal gasification, and experimental studies of gas-solids transport. Attention is also given to high-rate coal gasification, the influence of environment on coal conversion sites, jet fuels from synthetic crudes, gas turbine engine fuel from synthetic crude, an evaluation of coal-derived JP-5 fuels, environmental aspects of coal gasification, coal-based ammonia plant operation, and design concepts for a coal hydrocarbonization plant G R

A78-43404 Clean fuels from coal E P Stambaugh, J F Miller, S S Tam, S P Chauhan, H F Feldmann, H E Carlton, H Nack, and J H Oxley (Battelle Memorial Institute, Columbus, Ohio) In Coal processing technology Volume 3 New York, American Institute of Chemical Engineers, 1977, p 1-4

A description is presented of a new coal desulfurization process which is based on heating a water coal slurry and a leaching agent at moderate temperatures and pressures. The technology involved promises to be an excellent process for reducing the sulfur level of high-sulfur coals to meet Federal sulfur emission standards. The reported process has successfully extracted up to 99% of the pyritic sulfur and up to 70% of the organic sulfur in both batch laboratory experiments and small-scale pre-pilot plant continuous operation to produce a clean solid fuel for electric utilities, industrial boilers, schools, and any facility using coal as the source of energy. The primary end products of the process are clean solid fuel and elemental sulfur, which can be marketed or easily stored. Sodium hydroxide and calcium hydroxide have been identified as the most promising leaching agents G R

A78-43405 Uses for fluidized bed coal combustion. A P Fraas (Oak Ridge National Laboratory, Oak Ridge, Tenn.) In Coal processing technology Volume 3 New York, American Institute of Chemical Engineers, 1977, p 5-11 18 refs

It is pointed out that burning coal in a fluidized bed offers an intriguing means of obtaining electricity as well as high-temperature process heat from many types of coal fuels, and with no need for costly air pollution control systems in the stack emission. Coal fuels which can be used employ lignite and high sulfur bituminous coal. The thermodynamic cycles that appear most attractive are a closed cycle gas turbine and a cesium- or potassium-steam binary vapor cycle. The former has the advantage that it is more conventional whereas the latter gives a higher efficiency for the production of electricity. The potassium (or cesium) cycle has the additional advantage that it makes clean process heat available at any given constant temperature up to 1540 F G R

A78-43406 Coal-fired MHD power generation A J Kumnick (Montana State University, Bozeman, Mont.) In Coal processing technology Volume 3 New York, American Institute of Chemical Engineers, 1977, p 12-15 12 refs

The first MHD generator, which became a laboratory reality in 1959, produced 11.5 kW of electric power. The interest in MHD generators is related to their potential of converting fossil fuel (particularly coal) to electricity at a higher efficiency than existing technologies. In an MHD generator of the considered type, the metal armatures of a conventional turbogenerator are replaced by a very hot conducting gas moving at a high velocity perpendicular to a magnetic field. In the operation of an open cycle coal-fired MHD generator, the gas is combustion gas which is obtained by burning pulverized coal with preheated air. The electrical conductivity of the gas is increased by the addition of a 'seed' material such as

potassium. Critical problem areas regarding the development of a commercially feasible MHD system are examined G R

A78-43407 The environmental influence of coal liquefaction E M Magee, C E Jahng, and C D Kalfaldelis (Exxon Research and Engineering Co., Linden, NJ.) In Coal processing technology Volume 3 New York, American Institute of Chemical Engineers, 1977, p 16-22 20 refs

The coal-processing plants required to replace a significant fraction of the U.S. oil consumption by synthetic liquids derived from coal could potentially represent a formidable source of environmental pollution. An investigation was in this connection conducted regarding the environmental influence of coal liquefaction processes. Effects on the environment are related to the natural resources consumed and the effluents emitted. Water is required for the processing operations. The requirements for water are a very critical factor in many western areas where coal is abundant but water is scarce. The principal emissions of concern are huge quantities of gaseous, liquid, and solid effluents, as well as waste heat. The composition of stack gases from the processes depends on the fuel which is used G R

A78-43408 Presulfiding coal liquid hydrodesulfurization catalysts M M Ahmed and B L Crynes (Oklahoma State University, Stillwater, Okla.) In Coal processing technology Volume 3 New York, American Institute of Chemical Engineers, 1977, p 23-27 11 refs

Some coal liquefaction processes under consideration may require secondary hydrotreatment with hydrodesulfurization (HDS) as an important step in upgrading the coal-derived liquids. A specialized program developed for HDS is discussed. A trickle bed reactor is used in the conducted experiments. The significance of the obtained results is considered. It is found that the total amount of H₂S supplied during catalyst presulfiding has an effect on the catalyst activity. A relatively small amount of H₂S results in a lower activity of the catalyst. The activity of the catalyst decreases also when the sulfided catalyst is treated with pure hydrogen G R

A78-43409 Evaluation of coal carbonization processes J M Holmes, H D Cochran, Jr., M S Edwards, D S Joy, and P M. Lantz (Oak Ridge National Laboratory, Oak Ridge, Tenn.) In Coal processing technology Volume 3 New York, American Institute of Chemical Engineers, 1977, p 40-46 8 refs

The reported survey shows that a number of processes for the carbonization and hydrocarbonization of bituminous coals are available. However, only the development of the Lurgi-Ruhrgas process has currently reached the commercial stage. The others are in various stages of development, including the Coalcon process, which is currently being scaled for a use in a demonstration plant. A wide range of yields can be obtained by these processes which are primarily dependent upon coal rank and process operating conditions. Agglomeration of the coal during carbonization can be prevented by a variety of methods. An attractive approach appears to be the bed recirculation method. Desulfurization of the liquid and char products can be achieved by additional treatment with hydrogen G R

A78-43410 Alternatives to stack-gas scrubbing J M Evans (Enviro Control, Inc., Rockville, Md.) In Coal processing technology Volume 3 New York, American Institute of Chemical Engineers, 1977, p 47-52 25 refs

Physical coal beneficiation processes considered include a coal-agglomeration process, a multistream coal cleaning system, two-stage froth flotation, electrophoretic separation, and magnetic separation. Chemical processes investigated are related to a hydrothermal process, an oxygen leaching process, 'sulfur oxidation', chemical comminution, and chemical cleaning. A description is presented of the approaches used to obtain accurate specific gravity control in a multistream technique. Physical and chemical methods employed to reduce particle size are discussed along with the

concepts involved in chemical leaching. The important parameters of chemical coal cleaning processes are presented in a table G R

A78-43411 Effluents from Synthane gasification of lignite. M J Massey (Carnegie-Mellon University, Pittsburgh, Pa.), D V. Nakles, A J Forney, and W. P Haynes (U.S. Department of Energy, Pittsburgh, Pa.) In Coal processing technology Volume 3. New York, American Institute of Chemical Engineers, 1977, p 53-59 8 refs.

An extensive experimental program was initiated to study quantitatively the nature of effluent production and the various gasifier process variables which affect it. The investigation included studies of the rates of production of various gasifier effluents as a function of time from gasifier startup to shutdown and the effects of changes in selected process variables on the rate of production of various effluents. The associated effects of changes in these variables on yields of total product gas and equivalent methane were also examined along with the impacts of changes in selected process variables on the composition and physical properties of char and tar produced. Attention is given to the equipment arrangement for gasification trials, the effect of coal injection geometry, and the mechanisms responsible for the observed results G,R

A78-43412 Pressurized feed for coal gasification A H Furman (General Electric Co., Schenectady, N.Y.) In Coal processing technology Volume 3. New York, American Institute of Chemical Engineers, 1977, p 60-65 Research sponsored by the Electric Power Research Institute

A description is presented of a continuous 'cold' coal extrusion process to compact and feed coal fines directly into a pressurized gasifier. This process is to make it possible to utilize coal fines which cannot be processed in conventional fixed-bed gasifiers. Such a utilization of fines is economically important because mine coal can contain as much as 30%-40% fines. In the described process, screened coal fines are mixed with a tar binder and fed into the hopper of the extruder. The mix is conveyed down the barrel by a screw and compressed into a solid continuous rod of extrudate in the die area. A two-inch extruder was employed in the first scale-up of the process. It was found that the screw component was subjected to much wear. A screw/ram device was designed in an effort to overcome these difficulties. Other problems which had to be solved were related to pressure maintenance and variations in the characteristics of the coal G R

A78-43413 Purification processes for coal gasification. D K Fleming and H S Primack (Institute of Gas Technology, Chicago, Ill.) In Coal processing technology Volume 3 (A78-43403 19-44) New York, American Institute of Chemical Engineers, 1977, p 66-78 47 refs

A review is conducted of purification processes for gas streams generated in high-Btu coal gasification processes. Particular attention is given to systems for sulfur removal and recovery from the raw product gas and for cleaning the Claus plant tail gas. Certain problems are created by the variations in the coal properties. Therefore, the coal gasification facility has a feedstock that cannot be adequately characterized, but is known to vary widely. The group of systems that remove sulfurous compounds and carbon dioxide from gases are generically called acid-gas removal processes. The selection of an acid-gas removal system will depend, in part, upon the process chosen for treating the off-gas for sulfur recovery. In general, it is economically preferable to process as much of the gas through a Claus process as possible. Attention is given to selectivity in acid-gas removal, the use of alkanolamines, the employment of physical solvents, and details regarding the Claus process G R

A78-43414 High rate coal gasification R L Coates (Eyring Research Institute, Provo, Utah) In Coal processing technology Volume 3. New York, American Institute of Chemical Engineers, 1977, p 89-94 Contract No E(49-18)-1548

Studies of pressurized gasification of coal in experimental entrained flow gasifiers conducted between 1953 and 1962 by the U.S. Bureau of Mines has demonstrated that the reaction of pulverized bituminous coal with oxygen and steam could be efficiently carried out at gasifier coal throughput rates as high as 500 lb/hr/cu ft of reaction-zone volume. This rate is more than an order of magnitude greater than the volumetric throughput rates of existing commercial stirred-bed gasifiers. A description is presented of an experimental gasifier similar to the Bureau of Mines design, but with provisions for recovering sensible heat from the product stream. Recent results are also reported in which efficient gasification has been achieved at throughput rates of 1000 lb/hr/ft. The pulverized coal, entrained in a recycled stream of product gas, and a mixture of preheated oxygen and superheated steam are fed to the top of the gasifier. Attention is given to a design employed to prevent slag solidification, results obtained with Utah bituminous coal, and a comparison with prior data G R

A78-43415 * Jet fuels from synthetic crudes A C Antoine (NASA, Lewis Research Center, Cleveland, Ohio) and J P Gallagher (A*antic Richfield Co., Harvey, Ill.) In Coal processing technology Volume 3. New York, American Institute of Chemical Engineers, 1977, p 107-114 Contract No NAS3-19747

An investigation was conducted to determine the technical problems in the conversion of a significant portion of a barrel of either a shale oil or a coal synthetic crude oil into a suitable aviation turbine fuel. Three syncrudes were used, one from shale and two from coal, chosen as representative of typical crudes from future commercial production. The material was used to produce jet fuels of varying specifications by distillation, hydrotreating, and hydrocracking. Attention is given to process requirements, hydrotreating process conditions, the methods used to analyze the final products, the conditions for shale oil processing, and the coal liquid processing conditions. The results of the investigation show that jet fuels of defined specifications can be made from oil shale and coal syncrudes using readily available commercial processes G R

A78-43416 Gas turbine engine fuel from synthetic crude F S Eisen and J D Tice (Suntech, Inc., Marcus Hook, Pa.) In Coal processing technology Volume 3. New York, American Institute of Chemical Engineers, 1977, p 115-121 7 refs

In an effort to expand the domestic supply base for liquid fuel, a program was initiated to evaluate the suitability of synthetic fuels (from coal, oil shale, and tar sands) for DOD needs. In this connection a contract was awarded to an American company to produce jet fuel from coal-derived synthetic crude oil. The objective was to provide JP-5 type jet fuel samples for testing. In the first phase of the project four 10-gal lots of jet fuel were prepared from coal syncrude. During the second phase 250 gal were produced of one of the fuels. The investigation shows that gas turbine engine fuels having 2-25 vol % aromatics, which meet most current JP-5 specifications, can be produced from the coal syncrudes tested. Severe hydrogenation conditions are required to reduce the aromatic content of the coal syncrude kerosene fraction to 20-25 vol % in one stage. Meeting the current JP-5 smoke point specification will be difficult for coal-derived fuels with aromatics greater than 20 vol % or so G R

A78-43417 Evaluation of coal-derived JP-5 fuels C J Nowack, J Solash, and R J Delfosse (U.S. Naval Air Propulsion Test Center, Trenton, N.J.) In Coal processing technology Volume 3. New York, American Institute of Chemical Engineers, 1977, p 122-126 5 refs

On the basis of an evaluation of the data obtained in the pilot plant experiment of an American company, it is concluded that it will be difficult to convert coal syncrudes from the Char Oil Energy Development process into a jet fuel having all the properties of the present MIL-T-5624K specification for grade JP-5 fuel. Those properties which will not be acceptable for a wide boiling range fuel; having an end point of 575 F, are specific gravity, viscosity, and smoke point on a 25% aromatic level. Development work on refining

coal syncrudes should be conducted to improve process variables. This work should also include the development of catalysts that are resistant to those compounds in coal syncrudes which are responsible for deactivation. Both high and low aromatic fuels derived from Utah and Western Kentucky coals had acceptable storage and thermal oxidation stability. G R

A78-43418 Environmental aspects of coal gasification. C E Jahnig and R R Bertrand (Exxon Research and Engineering Co., Linden, N.J.) In Coal processing technology Volume 3. New York, American Institute of Chemical Engineers, 1977, p 127-132. 17 refs.

It would take about 80 large plants for converting coal to synthetic natural gas to provide clean fuel equivalent to 20% of the U.S. current oil consumption. Required new supplies of coal will be over 300 million ton/yr compared to current production of about 600 million ton/yr. Detailed evaluations have been conducted concerning the impact of this new coal conversion industry on the environment. Specific areas of concern are related to solids disposal, emissions to the air, water effluents, and trace metals. The area of trace elements warrants special mention because a large number of toxic trace elements have considerable volatility in the gasifier and become concentrated in the raw gas clean up system. Specific methods will have to be developed for their recovery or proper disposal. Approaches for environmental controls are discussed, taking into account cooling and scrubbing, water clean up, acid gas removal, and solids disposal. G R

A78-43419 The Exxon donor solvent process. L E Furlong, E Effron, L W Vernon, and E L Wilson (Exxon Research and Engineering Co., Baytown, Tex.) In Coal processing technology Volume 3. New York, American Institute of Chemical Engineers, 1977, p 145-151. 6 refs.

In the present paper, Exxon's research work on coal liquefaction is reviewed, and the currently envisioned commercial EDS process is outlined. Particular attention is given to the donor solvent, the currently operating 1-ton/day pilot plant, and the nature of the liquid products. The principal steps of the EDS process directed toward production of naphtha blending components and low-sulfur fuel oil are discussed, and the basic requirements and specifications for a 250-ton/day pilot unit are established. V P

A78-43420 Fluid bed processing of agglomerating coals. J Yerushalmi (New York, City University, New York, N.Y.) In Coal processing technology Volume 3. New York, American Institute of Chemical Engineers, 1977, p 156-165. 36 refs.

Fluid bed technologies for processing coal may benefit substantially if a caking coal could be fed directly to the bed without pretreatment. In the present paper, a number of techniques that might be employed to process a caking coal in fluidized beds are discussed, and a technical basis for each of the techniques is developed. Particular attention is given to means of achieving effective dispersal of raw particles of coal in the dry char that comprises the bed. V P

A78-43421 A fluidized-bed ash-agglomeration gasifier. W A Sandstrom, A G Rehmat, and W G Bair (Institute of Gas Technology, Chicago, Ill.) In Coal processing technology Volume 3. New York, American Institute of Chemical Engineers, 1977, p 180-186. Research sponsored by the American Gas Association and ERDA.

The test program described has provided conclusive evidence that high-ash-content agglomerates can be selectively removed on a steady-state long-term basis from a dense-phase fluidized bed of high carbon content. Carbon utilization is further improved by fines recycle, so that carbon gasification efficiencies over 95% are obtainable. In tests at near atmospheric pressure, it proved possible to obtain agglomerates of 65 to 95 percent ash content from a dense-phase fluidized bed with an average ash content between 22 and 28 percent. Higher bed temperatures were found to produce

higher ash-content agglomerates for a given feed particle size range. The average feed particle size appears to affect the bed temperature at which agglomerates begin to form. The required bed agglomerating temperature increases with decreasing particle size. Ferrous aluminum silicate eutectic was found to promote the formation of ash agglomerates. V P

A78-43422 The ADL extractive coking process. S A Reber, R M Nadkarni, R W Hyde, A H Schutte, and R P Stickles (Arthur D Little, Inc., Cambridge, Mass.) In Coal processing technology Volume 3. New York, American Institute of Chemical Engineers, 1977, p 187-193. 15 refs.

Coal liquefaction processes are considered and a description is presented of an extractive coking coal liquefaction process, called the ADL process. The process involves the use of a hydrogen-donor solvent under mild conditions to achieve the liquefaction and the use of cracking and coking to separate the product as an overhead vapor from the coal ash and the heavy portion of the coal extract. Pittsburgh seam coal is ground to 80% minus-200-mesh and dried. Coal is crushed and ground, then added to the coke drum along with mildly hydrogenated recycled solvent whose boiling range is approximately from 450-700 F. The coal and solvent react in the drum at about 750 F. The yield structure for the ADL process depends heavily upon process conditions, in particular, upon the coking pressure. Attention is given to process development unit and bench-scale data, a preliminary economic analysis, and the advantages of the ADL process over other processes. G R

A78-43492 # Operation of an electrohydrodynamic heat pipe against gravity. (O rabote elektrogidrodinamicheskoi teplovoi trubki protiv sil tiazhesti.) V D Shkilev. *Akademiia Nauk Moldavskoi SSR, Izvestiia, Seriya Fiziko-Tekhnicheskikh i Matematicheskikh Nauk*, no 1, 1978, p 89-91. 7 refs. In Russian.

The paper describes an experimental study of the possibility of achieving high efficiency heat transfer with an EHD heat pipe, with a high-voltage electrode situated only above the evaporation zone (an area of 20 sq cm). The working fluid was Freon-113, refrigerator temperature was maintained at about 16 C during the experiment. Consideration is given to the dependence of mean temperature of the evaporator on the specific heat flux and on the heat power of the pipe, the temperature profile along the pipe is presented. It is shown that the use of EHD effects is an efficient way to improve the performance of heat pipes that operate against gravity. B J

A78-43504 * # Design approaches to more energy efficient engines. N T. Saunders, R S Colladay, and L E Macioce (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Joint Propulsion Conference, 14th, Las Vegas, Nev., July 25-27, 1978, AIAA Paper 78-931*. 10 p. 5 refs.

In 1976 NASA initiated the Aircraft Energy Efficiency (ACEE) Program to assist in the development of technology for more fuel-efficient aircraft for commercial airline use. The Energy Efficient Engine (EEE) Project of the ACEE program is intended to lay the advanced-technology foundation for a new generation of turbofan engines. This project, planned as a seven-year cooperative government-industry effort, is aimed at developing and demonstrating advanced component and systems technologies for engines that could be introduced into airline service by the late 1980s or early 1990s. In addition to fuel savings, new engines must offer potential for being economically attractive to the airline users and environmentally acceptable. A description is presented of conceptual energy-efficient engine designs which offer potential for achieving all of the goals established for the EEE Project. G R

A78-43505 * # General aviation internal combustion engine research programs at NASA-Lewis Research Center. E A Willis (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Joint Propulsion Conference, 14th, Las Vegas, Nev., July 25-27, 1978, AIAA Paper 78-932*. 15 p. 17 refs.

An update is presented of non-turbine general aviation engine programs underway at the NASA-Lewis Research Center in Cleveland, Ohio. The program encompasses conventional, lightweight diesel and rotary engines. Its three major thrusts are (a) reduced SFC's, (b) improved fuels tolerance, and (c) reducing emissions. Current and planned future programs in such areas as lean operation, improved fuel management, advanced cooling techniques and advanced engine concepts, are described. These are expected to lay the technology base, by the mid to late 1980's, for engines whose life cycle fuel costs are 30 to 50% lower than today's conventional engines. (Author)

A78-43530 # An overview of the Satellite Power System - Transportation system. G M Hanley and R P Bergeron (Rockwell International Corp., Space Div., Seal Beach, Calif.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Joint Propulsion Conference, 14th, Las Vegas, Nev., July 25-27, 1978, AIAA Paper 78-975* 11 p 6 refs

A key element in the overall feasibility of the Satellite Power System (SPS) is the transportation concept either available or projected to be available in the time being considered. Since transportation costs contribute significantly to the total SPS life cycle cost, methods of reducing transportation cost or simplifying transportation operations greatly enhance the acceptance of the SPS concept. Major elements of the SPS transportation system consist of heavy lift launch vehicle (HLLV), Space Shuttle, cargo and personnel orbit transfer vehicles (COTV and POTV), and on-orbit mobility system (OOTV). A major driver in transportation system selection is the COTV concept used for transfer from low earth orbit (LEO) to geosynchronous equatorial orbit (GEO). Depending on COTV concept selection, two of every three launch vehicle flights to LEO may be required for OTV propellant resupply. Trade studies were conducted on SPS construction site (LEO or GEO) and COTV concepts (chemical, nuclear, and electric self powered or dedicated). A preferred system concept was selected on the basis of cost, operational complexity, and environmental considerations. (Author)

A78-43603 # Parameter optimization for engine control systems. W R Sertz (Bendix Research Laboratories, Southfield, Mich.) and S J Citron (Purdue University, West Lafayette, Ind.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Joint Propulsion Conference, 14th, Las Vegas, Nev., July 25-27, 1978, AIAA Paper 78-1105* 8 p 11 refs

This paper describes the steps followed in optimizing the design of an automotive engine control system. Adjustment of design parameters allows the control to be adapted to a particular engine, but the complexity of system interactions may limit the designer's ability to achieve optimum performance by intuitive feel alone. The system may be represented in the design process by an analytical model, a computer simulation, or indeed may be the actual engine hardware. Three techniques of parameter optimization are described, two of which have intuitive justification. The design approach is applied to the calibration of an electronic fuel injection and ignition control system. (Author)

A78-43613 # Study of solar energy systems for warm water production with natural circulation (Studie van zonneenergiesystemen voor warmwaterproductie met natuurlijke circulatie). C Van Geit and H Vasseur. Leuven, Katholieke Universiteit, Fakulteit der Toegepaste Wetenschappen, Burgerlijk Werktuigkundig Ingenieur Dissertation, 1977 150 p 22 refs In Dutch

The performance of a solar energy system for household warm water, in which the solar energy not only heats the water but is also responsible for the flow of the water, is analyzed with atmospheric conditions taken into account. First a theoretical study of the thermal losses of a flat-plate collector is carried out. These results are compared with some experimental data. A model of a complete system is developed, that permits one to calculate the temperature variation in the storage vat as a function of time. This model gives accurate results if the solar radiation varies in a regular manner. FORTRAN computer programs for all calculations are given. P T H

A78-43615 # Design of a measurement facility for determining the losses of a solar collector under standard conditions (Ontwerp van een meetopstelling voor het bepalen van de verliezen van een zonnepaneel onder standaardvoorwaarden). J Kegels and J Tiebout. Leuven, Katholieke Universiteit, Fakulteit der Toegepaste Wetenschappen, Burgerlijk Elektrotechnisch-Werktuigkundig Ingenieur Dissertation, 1977 119 p 14 refs In Dutch

A measuring facility is described in which it is possible to calculate the various kinds of losses in a flat-plate collector under controlled conditions. The basic part of the facility is a test chamber consisting of a box of small height. The bottom surface of the box is formed by the glass of the collector, the upper consists of perforated strips and slots. Cold air is blown through the holes in the strips perpendicular to the glass. The air is then sucked up along the slots. In this way convection losses are simulated. The strips also serve as counter upper surface in radiation exchange. Extensive loss measurement results are presented, and accuracy evaluations are carried out. P T H

A78-43618 # The PERICLES project (Le projet PERICLES). B Authier. *L'Astronomie*, vol 92, June 1978, p 265-275 5 refs In French

The use of spherical solar receptors in a simply constructed device and in the PERICLES project is examined. (PERICLES is an acronym derived from the French words for energy production in isolated regions by limited concentration of solar energy.) The optimum position, form, and size of a boiler associated with a spherical solar receptor is determined for an installation with a 200-400 kW peak. The efficiencies of spherical solar receptors of different types or locations are surveyed, and it is thought an exit temperature of 350 C can be obtained by use of this design. M L

A78-43700 Controlled nuclear fusion, a challenge for the engineer. IV - Systems and components for fusion reactors (Kontrollierte Kernfusion, eine Herausforderung an den Ingenieur. IV - Systeme und Komponenten für Fusionsreaktoren). H Frey (Leybold-Heraeus GmbH und Co., Hanau, West Germany). *VDI-Z*, vol 120, no 13, July 1978, p 641-645 In German

The design and the functions of the reactor blanket are discussed along with the electrical systems and components of the reactor. The blanket, a complex envelope structure surrounding the thermonuclear plasma, has important functions. These functions are related to the transformation of the kinetic energy of fusion neutrons into thermal energy, the breeding of tritium, and, in the case of reactors using magnetic containment, also the shielding of the superconducting coils. Tritium is produced in connection with processes involving the nuclear reaction of Li-6 and Li-7 with neutrons. The high diffusion rate of tritium through niobium can be utilized for its separation. Details concerning the fuel cycle of a fusion reactor, the tritium separation system, the lithium-potassium-steam cycle (direct cooling), and the lithium-helium cycle (indirect cooling) are illustrated with the aid of diagrams. Attention is also given to the structure of a Tokamak reactor with a thermal power of 5 GW, the design of a blanket module, the stored energy of magnetic-field coils with superconducting material as a function of mean current density, measurement and control technology, and power supply systems. G R

A78-43706 Organometallic-sourced VPE AlGaAs/GaAs concentrator solar cells having conversion efficiencies of 19%. N J Nelson, K K Johnson, R L Moon, H A Vander Plas, and L W James (Varian Associates, Inc., Palo Alto, Calif.) *Applied Physics Letters*, vol 33, July 1, 1978, p 26, 27 7 refs Contract No

A78-43725 Work function and Auger measurements of the initial oxidation of hydrogenated amorphous Si and of single-crystal Si. B Goldstein and D J Szostak (RCA Laboratories, Princeton, N J.) *Applied Physics Letters*, vol 33, July 1, 1978, p 85-87 13 refs

We have monitored the change in work function during the initial oxidation of discharge-produced amorphous Si(H) and corre-

lated this change with the amount of adsorbed oxygen as measured by Auger spectroscopy. With exposure to oxygen, the work function first increases (explained in terms of a dipole layer on the surface) and then decreases (explained in terms of penetration of oxygen below the surface). The explanation appears to be confirmed by similar measurements on the three primary crystallographic faces of single-crystal Si. Initial sticking coefficient and dipole strength of oxygen adsorbed on amorphous Si are given. (Author)

A78-43748 **Emission control technology for sulphur oxides and nitrogen oxides from flue gases in Japan** T. Ohtsuka and Y. Ishihara (Central Research Institute of Electrical Power Industry, Tokyo, Japan) (*Institute of Fuel, Conference on Advancing Energy Technology, Eastbourne, Sussex, England, Oct 31-Nov 2, 1977*) *Institute of Fuel, Journal*, vol 51, June 1978, p 82-90. 31 refs.

Flue-gas desulfurization plants installed in Japan total approximately 1000 units having a capacity of 93 x 10 to the 6th normal cu m/h as of late 1976. The 30 large-capacity plants installed in the electric power industry process flue gases of about 22 x 10 to the 6th normal cu m/h (equivalent to 7188 MW of power generation). To reduce emissions of nitrogen oxides, combustion modification systems have been installed in most of the boilers in the electric power industry. Many organizations have been developing various flue gas denitrification processes to reduce emissions of nitrogen oxides further. The catalytic reduction process has reached the commercial stage for processing 'clean gas', but for 'dirty gas', technical problems remain. Wet processes for flue gas denitrification have the advantage of removing both nitrogen oxides and sulfur oxides simultaneously. Therefore, various processes have been developed at pilot plants but several technical problems have not yet been solved. These are described. (Author)

A78-43749 **Photosynthesis in vitro** M. D. Arcner (Cambridge University, Cambridge, England) (*Institute of Fuel, Conference on Advancing Energy Technology, Eastbourne, Sussex, England, Oct 31-Nov 2, 1977*) *Institute of Fuel, Journal*, vol 51, June 1978, p 100-108. 47 refs.

Various methods of direct conversion of solar energy to electrical or chemical energy are reviewed. The principles that underlie photovoltaic cells, and the mechanism of photosynthesis in vivo are discussed, and loss factors which describe the operational efficiency of these two direct converters are defined. Newer, less highly developed photoelectrochemical and photochemical methods of solar energy conversion are described and their efficiencies are discussed in terms of the same loss factors. (Author)

A78-43750 **The future of geothermal energy** H. C. H. Armistead (*Institute of Fuel, Conference on Advancing Energy Technology, Eastbourne, Sussex, England, Oct 31-Nov 2, 1977*) *Institute of Fuel, Journal*, vol 51, June 1978, p 109-118. 9 refs.

A review of present and potential geothermal energy sources is presented noting hyperthermal and semithermal fields and large masses of hot rocks. Methods for rock fracturing, drilling, and deep fracture dilation are outlined. Estimates are made of the order of magnitude of extractable heat and its qualitative value. It is observed that geothermal heat causes the least pollution of all energy sources and that it is a relatively economical procedure. SCS

A78-43752 # **Criteria for choosing a regression model for the analysis and prediction of fuel-supply processes with a seasonal component** (Obosnovanie vybora regressiionnoi modeli dlia analiza i prognozirovaniia protsessov toplivonasabzheniia s sezonnoi sostavliaushchei) V. I. Zorkal'tsev (*Akademiia Nauk SSSR, Izvestiia, Energetika i Transport*, May June 1978, p 135-143. 7 refs. In Russian)

Two methods of time series analysis - the sliding mean formula and the regression equation - are compared with respect to their ability to predict trends and seasonal fluctuations on the basis of two criteria: (1) determination of a priori requirements placed on the method of computing components, and (2) determination of the maximum power of the polynomial with respect to the time which

represents the trend. The regression model does better according to both criteria. As an example, the regression model is used to predict seasonal volumes of coal consumption. BJ

A78-43771 **On photo fuel** J. O. Bockris and L. Handley (Flinders University, Adelaide, South Australia, Australia) *Energy Conversion*, vol 18, no 1, 1978, p 18-24. 24 refs.

The process of direct solar conversion of water into hydrogen and oxygen gas is discussed. The most important research goal is the attainment of a stable photoanode with a small energy gap (0.75-1.5 eV). Recent advances in cladding, stable photocathodes, and a stable working photodriven cell are characterized. Examined topics related to the optimization of photoelectrolysis include thermodynamic requirements, band bending, the reduction potential value, surface states, and doping of semiconductors. Photocorrosion and its possible prevention is considered. Present hydrogen generation efficiencies are only 0.1% with at least 5-10% needed for commercial utility. ML

A78-43772 **Economic analysis of heat transmission from low temperature geothermal sources** H. E. Kier (Connecticut University, Storrs, Conn.) *Energy Conversion*, vol 18, no 1, 1978, p 17-23. 9 refs. Contract No. E(10-1) 1628.

The costs of transmitting low-temperature geothermal water (150-300 F) were evaluated as a function of wellhead temperature, distance between the geothermal field and the energy usage site, and total energy demand of the system. It was found that transmission was not practical beyond 2-3 miles and that economies of scale are very important. Energy demand should be above 50,000,000 Btu/hr. For drying operations located within a three mile radius of a 270 F geothermal source, energy costs are within the \$1.50-\$3.00 per 1,000,000 Btu range and could become competitive. (Author)

A78-43773 **On the relation between insolation and climatological variables. V - Estimation of availability of solar energy** D. Rapp (Texas University, Richardson, Tex.) and A. A. J. Hoffman (Texas Christian University, Fort Worth, Tex.) *Energy Conversion*, vol 18, no 1, 1978, p 31-37.

A new procedure is developed for estimating availability of solar energy in localities where adequate data are not available. The hourly variations in solar intensity with day of the year during clear weather (essentially no clouds and unlimited visibility) are shown to follow regular repeatable patterns. These patterns have been determined for four southwestern locations. From these data, it is possible to estimate the maximum possible available solar energy for perfectly clear weather. The effect of clouds and reduction in visibility is to reduce the solar intensity below the value appropriate to any hour of any day in clear weather. A study of the dependence of reduction in solar intensity on cloud cover and visibility is now being conducted for several southwestern locations. A model for the dependence of direct normal solar intensity on total insolation is also being developed. (Author)

A78-43774 **On the relation between global insolation on horizontal and tilted surfaces** D. Rapp and D. Oxley (Texas University, Richardson, Tex.) *Energy Conversion*, vol 18, no 1, 1978, p 39-43. 6 refs.

Global insolation has been measured at many sites on a horizontal surface, but is needed on a tilted surface. A study has been made of patterns of global insolation for 12 months at Fort Hood, Texas, where measurements are made on both horizontal and tilted surfaces. The results indicate that, during clear weather, use of a geometrical formula for converting horizontal to tilted insolation for direct rays result in values 3.3% high. For the twelve month period March, 1976-February, 1977, including all weather, but only hours where the insolation on the tilted surface is greater than 22 Langley/hr, the geometrical formula is 4.6% high. It is concluded that the geometrical formula can be used with small corrections. (Author)

A78-43775 Two-phase flow in geopressured geothermal wells S K Garg and J W Pritchett (Systems, Science and Software, La Jolla, Calif.) *Energy Conversion*, vol 18, no 1, 1978, p 45-51 13 refs Contract No EY 76-C-5040-IS

The production characteristics of two-phase (free methane and liquid water with dissolved methane) geopressured geothermal wells are analyzed. The fluid flow in the aquifer is treated as single-phase (liquid water with dissolved methane) unsteady radial Darcian flow, two-phase flow is assumed to occur only in the cased part of the production hole. The mathematical model allows for different gas and liquid velocities in the two-phase regime. Sample calculations illustrate the effects on production of aquifer permeability and compressibility, the depth of the geopressured aquifer, the reservoir temperature, and the dissolved methane content of the aquifer fluids. (Author)

A78-43795 Long-term energy program related to regenerative sources (Langzeit-Energieprogramm aus regenerativen Quellen) H Seitz *Sonnenenergie*, vol 3, May/June 1978, p 7, 8, 11, 12 14 refs In German

It is pointed out that with respect to historical dimensions the epochs of fossil and nuclear energy generation are very brief time periods. In order to satisfy energy requirements on a long term basis, it is necessary to utilize existing natural energy streams. The huge potential of solar energy is in this connection considered. The question whether solar energy can satisfy human energy requirements leads to another question regarding the quantity of energy needed for the current standard of life. An investigation is conducted regarding the approaches which can be used to reduce energy losses as much as possible, taking into account conditions related to the use of low temperature heat, process heat and electric power, and fuels. The generation of low-temperature heat with the aid of solar energy is considered along with the various approaches available for the generation of electric power. It is proposed to combine wind-energy installations with solar cells at a ratio 4:1 for the generated energy. The yearly distribution of the supplied energy would in this case optimally approach the distribution of yearly energy demands and energy storage requirements would be low. Attention is also given to energy related to refuse and biological sources and the production of hydrogen. G R

A78-43796 Low-temperature heating systems and solar energy (Niedertemperaturheizungen und Sonnenenergie) A Urbanek *Sonnenenergie*, vol 3, May/June 1978, p 16-18, 21 7 refs In German

It has been generally recognized that an economical supply of heat for buildings is only possible with the aid of low-temperature systems. An investigation is, therefore, conducted regarding the central significance of low-temperature heating for future residential heating applications. It is pointed out that for the utilization of solar energy, directly via solar collectors or indirectly via heat pumps, a warm-water low-temperature heating system is a necessity for an optimal economical operation. The low-temperature system (+50/25 C) operates with lower heat losses than the customary central heating system (+90/70 C) and even the medium-temperature system (+70/50 C). Attention is given to a reduction of heat losses related to a utilization of low operational temperatures, advantages of floor heating, economical operational temperatures for collectors, a limiting temperature for heat pumps, and aspects of solar heating technology. G R

A78-43825 Unit helium requirements for superconductive energy applications in the USA M A Hlal (Wisconsin, University, Madison, Wis.), G E McIntosh (CTI, Denver, Colo.), E L Stone, and S W Van Sciver *Cryogenics*, vol 18, July 1978, p 415-422 36 refs U S Bureau of Mines Contract No PO480374

The paper provides estimates of the helium inventory and annual makeup needed for commercial size units of several high technology energy systems under study and development. The study considers superconductive magnetic energy storage, magnetically confined fusion reactors, superconducting power transmission lines, magnetohydrodynamic units, superconducting motors and genera-

tors, and particle accelerators. Estimates are based on published system studies and private information provided by various experts. Simple scaling laws are developed and used to calculate helium inventory where appropriate. Helium loss rates are discussed and used in estimates of annual helium makeup. M L.

A78-43881 A baseline of logistic and power requirements for full-scale manufacturing of metallic materials in earth orbit H Bloom (General Electric Co., Space Div., Valley Forge, Pa.) In *The Industrialization of Space, Proceedings of the Twenty-third Annual Meeting*, San Francisco, Calif., October 18-20, 1977. San Diego, Calif., American Astronautical Society, Univelt, Inc., 1978 22 p 11 refs (AAS 77 237)

A number of preliminary surveys have been carried out to identify potential space processed materials that might be of sufficient worth in earth-based applications to warrant their full-scale production in space. From these surveys, this paper extracts those quantities of materials to be transported and stored, physical parameters of production equipment and facilities, on-orbit operating needs, crew needs, and power requirements that are upper limits of space processing requirements. These data are then developed into a representative baseline of the logistics and power requirements of a future mature space manufacturing program. B J

A78-43922 Planar solar energy convertor and concentrator based on uranyl-doped glass R Reisfeld and S Neuman (Jerusalem, Hebrew University, Jerusalem, Israel) *Nature*, vol 274, July 13, 1978, p 144, 145 7 refs

The paper describes the use of a fluorescent plane uranyl-doped glass to convert and concentrate the UV and blue part of the solar spectrum. The device is able to dissipate the heat energy coming directly from the sun over the large area of the glass so that only the energy in the visible part of the spectrum will reach the solar cell. The excess between the absorbed energy and the band-gap energy which is evolved as heat in the solar cell can be diminished by decreasing the difference in wavelength between the useful and excess energy. When a rectangular slab of uranyl-doped glass is coupled to a silicon cell and excited by a high pressure mercury source, a considerable increase of current and voltage is obtained. The luminescence of uranyl does not fall in the spectral range of maximum sensitivity of silicon cells, energy transfer from the uranyl ion to an ion emitting closer to the maximum spectral sensitivity of silicon is recommended. M L

A78-43926 Solar-cell design based on a distributed diode analysis J L Boone and T P Van Doren (Missouri-Rolla, University, Rolla, Mo.) *IEEE Transactions on Electron Devices*, vol ED-25, July 1978, p 767-771 5 refs

The front surface of a p-n junction solar cell has resistive losses associated with the diffused layer, the metal-semiconductor contact, and the grid structure. These losses are analyzed by considering the spatially distributed nature of the p-n junction and the grid conductors. This distributed diode analysis is especially useful for solar cells operated under concentrated sunlight conditions. The results show the dependence of the V-I characteristics and the maximum power output per unit cell on the ratio of the diffused layer resistance to the junction dynamic resistance. This ratio can assist the designer in establishing proper grid structure geometries and should typically be less than 0.1 if the power output per unit cell is to be within 3% of that for the lossless case. Experimental measurements are reported which confirm the theoretical calculations. An analysis of the grid conductor losses associated with multiple-connected unit cells shows the disastrous effect that the grid header resistance can have on the performance of a solar cell. A tapered header conductor to decrease the metal coverage may actually worsen cell performance. (Author)

A78-43958 Railroad electrification and energy conservation. W D Middleton (U S Marine Corps Air Station, Iwakuni, Japan) *Traffic Quarterly*, vol 32, July 1978, p 383-397 10 refs

The history, use, and prospects of railroad electrification in the U S are discussed with reference to the costs and oil consumption associated with the use of diesel engines Capital investment requirements are considered the main obstacle to electrification Factors improving feasibility of electrification are examined, potentials for operating economies, impact of oil price increases, impact of national energy policy, and energy savings in freight movement are considered A table which lists existing railroad electrifications is presented The outlook for government assistance on electrification is examined with attention to the provisions of the 1976 4-R Act

M L

A78-43968 Solar cooling and heating: Architectural, engineering, and legal aspects. Proceedings of the Forum, Miami Beach, Fla, December 13-15, 1976 Volumes 1, 2, & 3. Forum supported by the Energy Research and Development Administration and University of Miami Edited by T N Veziroglu (Miami, University, Coral Gables, Fla) Washington, D C, Hemisphere Publishing Corp, 1978 Vol 1, 328 p., vol 2, 382 p., vol 3, 398 p Price of three volumes, \$120

Architectural considerations and solar buildings are discussed along with flat plate collectors, concentrating tracking collectors, concentrating passive collectors, aspects of energy storage, cooling systems, heating systems, cooling and heating systems, questions of system simulation and control, and economic and legal aspects Attention is given to the suntrap insulator/insulator, solar aesthetics and incentives, the solar energy research facility at the University of Texas at Arlington, an integrated wind/solar dwelling project, solar energy for the Hotel/Motel industry, an investigation into solar heating with some methods for convection suppression, the comparative performance of several flat plate designs, the characteristics of a subatmospheric distributed flow flat plate collector, the performance of low cost solar panels, a laboratory solar pond, heliostat structural stability as a function of solar heating and ambient temperature changes, the optimization of heat exchangers for solar concentrators, long duration earth storage of solar energy, the geothermal storage of solar energy for electric power generation, and a field study of a solar energy assisted heat pump heating system.

G R

A78-43969 Investigation into solar heating with some methods for convection suppression A A M Sayigh (Riyadh, University, Riyadh, Saudi Arabia) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla, December 13-15, 1976 Volume 1. Washington, D C, Hemisphere Publishing Corp, 1978, p 85-98 16 refs

This paper deals with convection suppression in flat plate collectors Seven 50 x 50 cm flat plate collectors made of 0.5 mm copper plate with copper pipes 10 cm apart carrying water and 4 mm glass covers were tested in Riyadh, Saudi Arabia Three of the collectors were filled with a honeycomb structure made of cylindrical, rectangular and square copper honeycomb Three of the remaining four were filled with different diameter of glass pyrex cylindrical honeycomb structures The seventh collector was left as it was (Author)

A78-43970 Comparative performance of several flat plate designs. M W Rupp (Olin Brass, East Alton, Ill) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla, December 13-15, 1976 Volume 1 Washington, D C, Hemisphere Publishing Corp, 1978, p 99-112 8 refs

Tests were run to experimentally determine the collector efficiency factor for several flat plate absorber designs The tests were performed outdoors using methods proposed by the National Bureau of Standards The results indicate good correlation between experimental and theoretical values The results also indicate that

commercially available absorber plates can achieve efficiency factors in the range of 98 to 99 (Author)

A78-43971 Thermal, fluid flow and mechanical characteristics of a subatmospheric distributed flow flat plate collector. D L Spencer, C A Foster, J W J Robinson, and R L Suter (Iowa, University, Iowa City, Iowa) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla, December 13-15, 1976 Volume 1 Washington, D C, Hemisphere Publishing Corp, 1978, p 113-135 5 refs Research supported by the Iowa Energy Policy Council

A78-43972 A design criterion on flat solar collectors based on thermal efficiency measurements S Lin (Concordia University, Montreal, Canada) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla, December 13-15, 1976 Volume 1 Washington, D.C, Hemisphere Publishing Corp, 1978, p 151-158 National Research Council of Canada Grant No A-7929

An experimental investigation of the effect of the geometric configuration of flat solar collectors on thermal efficiency has been conducted Three different solar collectors having the same surface area of 0.86 x 1.18 sq m have been designed, manufactured and tested Experimental results provide a general guideline for the design of flat solar collectors (Author)

A78-43973 Analytical model of flat plate solar collectors. R K McMordie (Martin Marietta Aerospace, Denver, Colo) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla, December 13-15, 1976 Volume 1 Washington, D C, Hemisphere Publishing Corp, 1978, p 195-224 Contract No E(40-1)-4941

The described model accounts for solar and IR radiation, conduction and convection losses to the ambient air, forced convection between the collector working fluid and the absorber plate, and conduction along the absorber plate between the fluid channels The model is based on an employment of the Martin Marietta Interactive Thermal Analysis System (MITAS) Attention is given to the solar collector thermal network, the transmissivities of the glass plates, the solar collector computer program input listing, the correlation of analytical and experimental data, analytical predictions regarding two aspects of collector design, collector performance as a function of solar absorptivity, and collector performance for two transparent covers G R

A78-43974 Optimal combinations of flat plate collector configurations P C Lobo, P I F Almeida, and E G O Nobrega (Paraitba, Universidade Federal, Joao Pessoa, Brazil) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla, December 13-15, 1976 Volume 1 Washington, D C, Hemisphere Publishing Corp, 1978, p 225-251 Research sponsored by the Financiadora de Estudos e Projetos

Flat plate collector configurations are compared on the basis of efficiency and economy for thermal and power plant applications. The performance is evaluated through numerical solution on a digital computer of the set of equations constituting a mathematical model of each collector configuration The performance envelopes that describe optimal collector combinations are expressed in terms of both efficiency and economy Three different absorber materials are considered, each with 1, 2 or 3 glass covers Two glass prices are used for calculations of collector economy Results demonstrate that the optimum collector design is a function of solar radiation flux, water outlet temperature desired, air temperature, absorber material and cost It is therefore very much a function of local conditions (Author)

A78-43975 The FMSC collector subsystem for the Sandia Solar Total Energy Facility G H Eggers and J L Russell (General Atomic Co, San Diego, Calif) In Solar cooling and heating

Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla., December 13-15, 1976 Volume 1 Washington, D.C., Hemisphere Publishing Corp., 1978, p 255-271

The Fixed Mirror Solar Concentrator (FMSC) concept can possibly provide an alternative to the use of high-cost steerable solar concentrators. The concept is related to the discovery that there is a particular trough-like shape which will reflect light to a sharp line focus regardless of the direction of the incident sunlight. The construction of the required large fixed structure would be less expensive than a comparable large moveable structure. With the mirror in a fixed position, it is necessary to move the receiver to track the focal line as it moves in response to the sun's daily and seasonal movements. Development work conducted for an implementation of FMSC concept is discussed. A metal frame-mounted working model is now delivering heated oil. A picture is presented of a cast concrete mirror with a 3.05-m aperture, recently cast to demonstrate this novel and potentially very inexpensive construction method. G R

A78-43976 Helio-stat structural stability as a function of solar heating and ambient temperature changes F M Cutting (Honeywell, Inc., St Petersburg, Fla.) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla., December 13-15, 1976 Volume 1 Washington, D.C., Hemisphere Publishing Corp., 1978, p 287-313 6 refs

There are indications that thermal expansion or distortions in helio-stat elements may create pointing errors of the order of accuracy required for efficient helio-stat operation. A numerical evaluation is, therefore, conducted regarding the effectiveness of various approaches intended to minimize such thermal expansion and distortion, taking into account the painting of machine elements with a white cellulose lacquer, the use of insulation, and the employment of solar shielding. It is found that a solar shield for each machine element offers the most effective solution to unsymmetrical heating. However, the cost of the louvered sheet metal panels, support framework, and brackets, may represent a significant cost impact. G R.

A78-43977 * A vacuum tube vee-trough collector for solar heating and air conditioning applications. M K Selcuk (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla., December 13-15, 1976 Volume 2 Washington, D.C., Hemisphere Publishing Corp., 1978, p 317-339 5 refs Contracts No. E(49-26)-1024, No. NAS7-100

An analysis is conducted of the performance of a vee-trough vacuum tube collector proposed for use in solar heating and cooling applications. The vee-trough reflector is a triangular sectioned, flat surfaced reflector, whose axis is laid in the East West direction. A vacuum tube receiver placed at the bottom of the vee-trough collects solar heat most efficiently since convection is completely eliminated. Radiation losses are reduced by use of selective coatings on the absorber. Owing to its high temperature capabilities (300-400 F), the proposed scheme could also be used for power generation applications in combination with an organic Rankine conversion system. It is especially recommended for unattended pumping stations since the reflectors only require reversal once every six months. G R

A78-43978 A solar collector based on an array of linear 'clipped-V' channels F A Bynum, R L Donnelly, and K C Bordoloi (Louisville, University, Louisville, Ky.) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla., December 13-15, 1976 Volume 2 Washington, D.C., Hemisphere Publishing Corp., 1978, p 341-349

An absorbing type air heating solar collector of clipped-V geometry is studied in terms of the effect of the variation of two geometric variables namely, the ratio between the width at the bottom of the channel and the width at the top of the channel and

the angle between the two side panels. The results indicate that there is a trade-off between the heat loss coefficient and the collector efficiency factor when these are considered as functions of the two above mentioned geometric variables. The studies were done assuming as fixed another set of variables such as those which determine the top loss coefficient and the radiative heat loss coefficient. Other variables which were held fixed were the width of the channel and the ratio between the flow length and five times the spacing between the glass covers and the bottom of the channel. Further studies need to be done in order to ascertain whether different assumptions made in modeling relations between the variables would produce significantly different results. (Author)

A78-43979 Design and operational evaluation of a non-tracking solar concentrator. J Villanueva and H V Truong (Florida Atlantic University, Boca Raton, Fla.) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla., December 13-15, 1976 Volume 2 Washington, D.C., Hemisphere Publishing Corp., 1978, p 351-365 9 refs

This paper is concerned with the design, construction and operational evaluation of a truncated nontracking concentrating solar collector of the type proposed by Winston (1975). The collector design was optimized for operation in the range of temperatures required to fire an absorption air-conditioning system with reasonable efficiency. The equilibrium temperature of the collector was measured with the solar radiation beam at angles of 0, 5, 10, and 15 deg with the optical axis of the collector and a solar intensity of 270 BTU/sq ft-hr. The measured equilibrium temperatures were 248 F at 10 deg of incidence and 230 F at 15 deg of incidence. The tests performed on the collector were in a temperature range of T(out) from 110 F to 194 F which can be considered moderate. However, the equilibrium temperatures measured (around 250 F at a solar intensity of 270 BTU/sq ft-hr) indicate that higher outlet temperatures are possible with better insulation around the storage tank and over the circulation system. (Author)

A78-43980 A moderately concentrating solar collector H S Robertson (Miami, University, Coral Gables, Fla.) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla., December 13-15, 1976 Volume 2 Washington, D.C., Hemisphere Publishing Corp., 1978, p 377-381

The collector described and analyzed in this paper has the properties that it collects radiation from the whole sky while concentrating the beam radiation by a factor of 1.3-1.6. Its performance, at worst, equals that of a comparable flat-plate collector, and when the sun is shining it provides significantly higher output temperatures and efficiencies. In a typical example, if the comparable flat-plate collector produces fluid at 180 F and 40% efficiency, the collector described will give 204 F at 50% efficiency and the same flow rate or 210 F at reduced flow rate and 40% efficiency. The gains in output temperature occur in a range of considerable importance to the performance of solar absorption air conditioners, and appreciable improvement should result from the use of this collector. (Author)

A78-43981 Optimization of heat exchangers for solar concentrators P R Damshala and J R Williams (Georgia Institute of Technology, Atlanta, Ga.) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla., December 13-15, 1976 Volume 2 Washington, D.C., Hemisphere Publishing Corp., 1978, p 383-407 9 refs ERDA-supported research

A parametric study is done on heat exchangers to be used for cylindrical fixed mirror concentrators. The operational parameters, such as inlet fluid temperature, solar insolation, fluid flow rate, ambient temperature and wind velocities, are varied. The geometrical parameters, the absorber plate width and the diameter of the embedded copper tubes are also varied. The results of variation of these parameters and their effect on thermal efficiency of the heat exchanger are presented in graphical form. A mathematical expres-

sion for predicting the thermal efficiency or exit fluid temperature is developed for a given solar data and inlet fluid temperature. The Rankine fluid (Toluene or Benzene) vaporized by the collector fluid (Therminol 66) in a heat exchanger is passed through a Rankine turbine to produce shaft power. The collector mean fluid temperature is optimized to produce the maximum power for a given solar insolation and ambient conditions. The overall efficiency of the solar system vs the mean collector fluid temperature are presented in graphical form for series and parallel connections of solar collectors. (Author)

A78-43982 **Geothermal storage of solar energy for electric power generation** R E Collins (Houston, University, Houston, Tex) and K E Davis (Subsurface, Inc., Bellaire, Tex). In *Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla., December 13-15, 1976* Volume 2. Washington, D C, Hemisphere Publishing Corp., 1978, p 411-424. 14 refs.

An investigation is conducted of a system for storing solar energy in the form of heat in permeable subsurface rock formations. The system envisioned consists of a well bore penetrating a deep lying porous permeable aquifer of considerable thickness. High pressure hot water or superheated steam would, when injected into the aquifer, displace the resident brine away from the well bore. After an initial period of 12 days for the establishment of the required conditions, about one third to two thirds of each day's production of solar energy would be injected during daylight hours for retrieval at night. Attention is given to a theoretical analysis of the thermal losses, the well system, aspects of well design, site selection, environmental considerations, and economics. On the basis of the investigation it is concluded that the considered method of solar energy storage might have the potential for providing a solar energy system for baseline electric power generation. G R

A78-43983 **Some experimental data for thermal pile energy storage** A A M Sayigh and M R Shaalan (Riyadh, University, Riyadh, Saudi Arabia). In *Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla., December 13-15, 1976* Volume 2. Washington, D C, Hemisphere Publishing Corp., 1978, p 425-444. 13 refs.

A description is presented of a theoretical analysis and an experimental investigation regarding the possibility to use rocks for thermal storage applications in connection with the utilization of solar energy. The theoretical analysis reported is concerned with the mathematical relations governing the flow of air through packed beds. In the experimental investigation a number of materials were tested separately concerning their suitability for storing a given amount of heat. Twenty-four thermocouples were used to record the temperatures at various locations in the employed container. It was found that the best thermal storage material available in Saudi Arabia is limestone. Other materials studied include sandstone, petrified wood, concrete, water bottles, bricks, glass balls, and steel balls. G R

A78-43984 **Long duration earth storage of solar energy** S W Yuan, A M Bloom, and M Nazli (George Washington University, Washington, D C). In *Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla., December 13-15, 1976* Volume 2. Washington, D C, Hemisphere Publishing Corp., 1978, p 445-457. 5 refs.

This investigation analyzes the heat transfer characteristics of long-duration storage of solar energy in an earth reservoir. The heat input to the earth storage is provided for by the operation of solar collectors. A water pipe heat exchanger is used to (1) distribute the solar collected heat throughout the earth storage and (2) extract heat from the earth storage for space heating. The solar collection process is performed each day and is shut off during the night. Solar energy is collected in this manner throughout the entire year and stored in the earth reservoir. For space heating applications house load data is

applied to the earth storage during the winter months. It is demonstrated that year round solar collection and approximately 400,000 cu ft of earth storage are adequate to provide space heating for twelve average size houses in most areas of the United States. (Author)

A78-43985 **On the prediction of melting rate in a solar energy storage subsystem utilizing latent heat** M N Ozisik and K J Mody (North Carolina State University, Raleigh, N C). In *Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla., December 13-15, 1976* Volume 2. Washington, D C, Hemisphere Publishing Corp., 1978, p 471-479.

A method of analysis is presented for the determination of the rate of melting in a solar energy storage subsystem in which a phase change material in the form of a slab is heated with channel flow over its bounding surfaces. The results of the analysis are presented in dimensionless form for the thickness of the melt layer and the temperature of the fluid along the channel as a function of time and position over a range of parameters of practical interest. (Author)

A78-43987 **Field study of a solar energy assisted heat pump heating system** S F Gilman, E R McLaughlin (Pennsylvania State University, University Park, Pa), and M W Wildin (New Mexico, University, Albuquerque, N Mex). In *Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla., December 13-15, 1976* Volume 2. Washington, D C, Hemisphere Publishing Corp., 1978, p 577-614. NSF ERDA supported research.

A description is presented of a portion of a project involving a field evaluation of an existing solar energy assisted heat pump in a commercial office building. The Solar Building has a solar-heated floor area of 5000 sq ft, that is separated from a conventionally heated and cooled portion by means of fixed partitions and doors equipped with door closers. The performance of the solar collector used is comparable to currently available liquid types. It is found that the relative amounts of direct heating and heat pump heating have considerable influence on the seasonal performance factor. These amounts are dependent on many variables, such as the building, its use, and the local climate. The completion of a computer model will permit studying the influences of these variables as well as predict the energy consumption over the entire winter period. G R

A78-43988 **Second-law assessment of solar heating and cooling systems** J E Lay (Michigan State University, East Lansing, Mich). In *Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla., December 13-15, 1976* Volume 3. Washington, D C, Hemisphere Publishing Corp., 1978, p 701-722. 15 refs.

Service hot water and residential heating and cooling are the first significant applications of solar energy in the latter part of the twentieth century. The technology is well developed, the systems are known to be viable, and the costs of solar heating are competitive with conventional fuels in many parts of the country. This paper presents a thermodynamic analysis of present solar systems and proposes a second-law efficiency rating in lieu of the standard first law efficiency rating for the evaluation of the performance of energy conversion devices. The second law efficiency is defined as the ratio of the least available work to perform an energy transfer to the actual available work to perform the transfer. All the second law efficiencies presented are extremely low, proving that present systems are far from ideal. It is, however, within reach of present technology to achieve higher second law efficiencies. (Author)

A78-43989 * **Alternate working fluids for solar air conditioning applications** R D Evans and J K Beck (Florida Technological University, Orlando, Fla). In *Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla., December 13-15, 1976* Volume 3.

Washington, D C , Hemisphere Publishing Corp , 1978, p 737-746 9 refs Contract No NAS8-30756

An experimental investigation of sixteen different refrigerant-absorbent fluid pairs has been carried out in order to determine their suitability as the working fluid in a solar-powered absorption cycle air conditioner. The criteria used in the initial selection of a refrigerant-absorbent pair included high affinity (large negative deviation from Raoult's Law), high solubility, low specific heat, low viscosity, stability, corrosive properties, safety, and cost. For practical solar considerations of a fluid pair, refrigerants were selected with low boiling points whereas absorbent fluids were selected with a boiling point considerably above that of the refrigerant. Additional restrictions are determined by the operating temperatures of the absorber and the generator, these temperatures were specified as 100 F (39 C) and 170 F (77 C). Data are presented for a few selected pressures at the specified absorber and generator temperatures (Author)

A78-43990 Solar energy powered domestic air conditioner for solar day operation A F Romero and G Best (Universidad Nacional Autonoma de Mexico, Mexico City, Mexico) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla , December 13-15, 1976 Volume 3 Washington, D C , Hemisphere Publishing Corp , 1978, p 771-778

A solar air conditioning unit has been designed based on an NH₃-H₂O-H₂ cycle which requires no moving part except the air fan at the evaporator. The system was a two ton evaporator and the design operating conditions are those of the city of Mexicali, Baja California Norte, Mexico, where temperatures of more than 308 K are not uncommon, but where an average of 272 sunny days per year and a mean annual daily radiation of 500 cal/sq cm per day permit a theoretical coefficient of performance (COP) of 0.609, even at generating temperatures as low as 353 K (Author)

A78-43991 Stirling cycle solar cooling system R I Pedrosa (American Industrial Systems, Inc, Miami, Fla) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla , December 13-15, 1976 Volume 3 Washington, D C , Hemisphere Publishing Corp , 1978, p 793-799 8 refs

The Stirling cycle engine is considered for application to solar powered cooling systems. Two approaches are possible. First, the use of a Stirling engine transmitting mechanical power to any type of cooling unit, and the integral design of a Stirling engine and cooling system. The first approach offers more flexibility in the design of the engine and allows for a broader selection of cooling systems. The integral design would use a single drive mechanism for both the engine and cooling units, thereby, reducing total mechanical friction and possibly offering a better efficiency. The integral design would be self contained using the same working fluid in the cooling cycle as in the engine (Author)

A78-43992 Dynamic simulation of a solar powered Rankine cycle/vapor compression cycle (RC/VCC) R W Allen, D K Anand, and A N Egrikan (Maryland, University, College Park, Md) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla , December 13-15, 1976 Volume 3 Washington, D C , Hemisphere Publishing Corp , 1978, p 803-814 9 refs Contract No E(40 1)-4976

A simple solar air conditioning system incorporating a Rankine cycle vapor compression cycle (RC/VCC) cooling subsystem is simulated by means of equations RC/VCC overall (heating-to-cooling) cycle coefficient of performance (OCCOP) is reported as a function of input temperatures for sample design point models and for sample off-design models. Off-design capacity performance of a sample RC/VCC subsystem is reported. Sample RC/VCC subsystems with selected design and off-design OCCOP characteristics are coupled to high and moderate performance collectors and the hourly, daily, and weekly performance is determined in terms of the

system (insolation-to-cooling) coefficient of performance (SCOP). Selected parametric effects are described (Author)

A78-43993 Dynamic modelling of solar energy systems using DYNYSYS A I Johnson and H N Nwagha (Western Ontario, University, London, Canada) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla , December 13-15, 1976 Volume 3 Washington, D C , Hemisphere Publishing Corp , 1978, p 815-830 14 refs

DYNYSYS, an acronym for DYNamic SYstems Simulator, is a modular problem-oriented executive program based on matrix combination structure to allocate streams and equipment information. A main executive program performs all the control operations for the computer system such as printing and graphics, calls for input data reading, calculations, and checking and writing output results. Various matrices are used to store information which describes the simulation network, the equipment parameters and component properties, and the state of the various streams at the predictor and corrector steps. In solar energy systems modeling, different modules describe the collector, heat exchanger, storage tanks, valves, controllers, absorption systems (comprising the generator, evaporator, condenser, absorber and cooling tower). The modeling so far is confined to home heating and cooling (Author)

A78-43994 Study on parameter variations for solar powered lithium bromide absorption cooling W F Bessler and C N Shen (Rensselaer Polytechnic Institute, Troy, NY) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla , December 13-15, 1976 Volume 3 Washington, D C , Hemisphere Publishing Corp , 1978, p 847-864 6 refs

This paper investigates methods of improving the performance from an economic and performance standpoint of a solar system by varying the pertinent parameters. Use of solar energy is considered to provide a low temperature heat source to power an absorption cycle refrigeration to be used in the cooling of buildings. The variables that are investigated are mass flow rate, temperature of condenser, absorber, evaporation to determine the effect on the coefficient of performance, to study the system sensitivity and to optimize system performance. The concept of latent heat storage within the absorption-cycle is examined by a computer program to account for all important temperature and flow parameters so that sensitivity and optimization studies can be made with respect to temperature flows and storage requirements (Author)

A78-43995 Simulation of a solar assisted and open cycle cooling/system using air as the transport medium R L Gamble (Ohio State University, Cincinnati, Ohio) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla , December 13-15, 1976 Volume 3 Washington, D C , Hemisphere Publishing Corp , 1978, p 865-893 10 refs

This paper presents the formulation of a model of a solar-assisted air-transport conditioning system for a typical residential home. The model simulates five major equipment components and two supportive units. The operation of the system depends basically on the functioning of the transfer of heat between rotary air heat exchangers. Cooling effect is provided to circulating air by the transfer of moisture from one wheel to another, as does the Munter's Environmental Unit (MEC) now being tested in prototype by the Institute of Gas Technology. Results of the mathematical formulation of the model are analyzed using actual solar and weather data. The results identify the operating ranges, constraints, and thermal efficiency of the system. Operating curves are presented, and the performance of this and other systems are compared. The validity of the model and the feasibility of the cooling apparatus within various operating and ambient temperature ranges are discussed (Author)

A78-43996 Comparison of simulated solar cooling systems in Saudi Arabia R L Jenks, A Kremheller (Petroleum and Minerals University, Dhahran, Saudi Arabia), and R W Jones (South Dakota,

University, Vermillion, S Dak.) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla., December 13-15, 1976 Volume 3 Washington, D C, Hemisphere Publishing Corp., 1978, p 907-920 15 refs

Solar-powered space cooling of buildings in the Gulf region of Saudi Arabia is simulated by digital computer The cooling is achieved by a lithium bromide-water absorption air conditioner powered by hot water supplied by flat-plate solar collectors The Gulf region has a cooling season which combines high temperature and high relative humidity This extreme climate provides a rigorous test of the feasibility of space cooling under severe conditions Two different systems of energy storage are simulated one in which hot water from the solar collectors is stored and used to drive the air conditioner which directly cools the building, and the other in which the air conditioner is operated as a water chiller, the cold water being stored and used, as required, for cooling Present results indicate that a combined system appears desirable, since it will provide nearly the total cooling load of a building with a solar-collector area of about one-third of the floor area of the building (Author)

A78-43997 **Solar energy coupled networks** J R Marks, P D Lonski, K M Casey, and L A Madonna (Widener College, Chester, Pa.) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla December 13-15, 1976 Volume 3 Washington, D C, Hemisphere Publishing Corp., 1978, p 939-954

The paper presents an analysis of the coupling networks associated with solar energy absorbing systems The networks are treated as phase spaces, and, in the investigated problem, two phase spaces are coupled through the use of a transduction element which is the turbine Matrix-type mathematical models for the phase spaces are constructed by assigning every piece of equipment a number and calling that piece of equipment a network node The transport equation is transposed and subtracted from the original expression to generate a generalized Kirchhoff matrix equation which shows all net energy or matter flows from each node In general, two Kirchhoffian expressions, one for energy and the other for matter, are required

M L

A78-43998 **The differential cost of a solar energy system completing the assessment.** R H Rand (Ballinger, Architects and Engineers, Philadelphia, Pa.) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla., December 13-15, 1976 Volume 3 Washington, D C, Hemisphere Publishing Corp., 1978, p 1005-1015

It is suggested that cost analyses of solar heating and cooling should take related implementation costs, land and space costs, and time-generated costs into account in addition to costs directly attributable to solar energy equipment and resultant changes in energy consumption Related implementation costs include the design and construction of structural support, weathertight integrity, and environmental control systems Site configuration and orientation may increase land cost, reduce building size, or introduce structural complexity, it is estimated that any of these can generate a premium equal to 1% of land plus building cost Time-related costs include taxes, interest on construction loans, escalation, and delayed return on investment An example cost analysis involving support, land, space, and time costs is presented

M L

A78-43999 **Considerations in the development of a high performance per unit cost solar collector** W H Sims (Chamberlain Manufacturing Corp., Waterloo, Iowa) In Solar cooling and heating Architectural, engineering, and legal aspects, Proceedings of the Forum, Miami Beach, Fla., December 13-15, 1976 Volume 3 Washington, D C, Hemisphere Publishing Corp., 1978, p 1017-1031

The paper describes the development of a flat-plate solar collector which is capable of energy output levels commensurate with the requirements of driving an absorption refrigeration cycle while operating at efficiency levels in the 35-40% range

absorber surfaces of black chrome over nickel and black copper over copper were tested The primary consideration during development was to ensure the cost effectiveness of each component selected Comparative analyses were performed for many combinations of collector components, with major emphasis being placed on the glazing material and the absorber plate coating, both selective and nonselective Comparison of performance per unit cost figures for combinations of variables are presented

M L

A78-44047 **Buried impact craters in the Williston Basin and adjacent area** H B Sawatzky In Impact and explosion cratering Planetary and terrestrial implications, Proceedings of the Symposium on Planetary Cratering Mechanics, Flagstaff, Ariz., September 13-17, 1976 New York, Pergamon Press, Inc., 1977, p 461-480 17 refs

Five subsurface structures, either within or adjacent to the Williston Basin, reveal some of the essential ear-marks of terrestrial impact craters One (Viewfield, Saskatchewan) is a simple bowl-shaped crater and the remainder are complex models, which, in addition to the structurally elevated outer rim, also display a positive highly disturbed central core Two of these features appear to be Late Cretaceous, or younger, in age and three are dated as Jurassic-Triassic The Red Wing Creek, North Dakota and Viewfield, Saskatchewan geophysical anomalies (interpreted as buried impacts) have yielded commercial oil production, the former from the central area and the latter from the outer rim Some interesting hydrocarbon occurrences are indicated at the other sites These too may be potential commercial oil producers but they have been inadequately explored to date

(Author)

A78-44097 **Photooxidation of aromatic hydrocarbons by Europium(III) salts** G Levin (New York, State University, Syracuse, N Y) *Journal of Physical Chemistry*, vol 82, July 13, 1978, p 1584-1588 15 refs NSF-supported research

Rate constants for the photooxidation of tetracene, perylene, coronene, and naphthalene in acetonitrile are reported Eu (3+) perchlorate or nitrate is used to photooxidize the compounds to their radical cations The reverse reaction occurs in the dark period The rate constants satisfactorily correlate with the reduction potential The rate constants for the oxidation of the excited singlets of tetracene and coronene by Eu (3+) were determined, but the triplets of tetracene and coronene are not oxidized by Eu (3+), which implies that the rate constants of these reactions are smaller than 1,000,000/M per sec

M L

A78-44107 **Materials compatibility problems in magnetic fusion energy - A review** E N C Daldor (U S Department of Energy, Div of Magnetic Fusion Energy, Washington, D C) *National Association of Corrosion Engineers, International Corrosion Forum Devoted Exclusively to the Protection and Performance of Materials, Houston, Tex., Mar 6-10, 1978, Paper 18* p 30 refs

A functional description of a tokamak power reactor is given, and types of corrosion and materials compatibility problems are discussed The structural material classes for fusion power are identified as austenitic stainless steels, heat-treatable N-Cr-Fe alloys, vanadium and its alloys, columbium and its alloys, molybdenum and its alloys, and titanium and its alloys Corrosive attack caused by impingement of energetic hydrogenous species from the plasma onto the first-wall structural material is examined relative to chemical reactions on metal surfaces, vaporization of the first-wall structural material, blistering and exfoliation, and near-surface wall modification One or more of the following changes in the first-wall structural material may be expected to occur phase changes, alloy composition changes, macrostructural changes, and changes in physical and mechanical properties Corrosion caused by interaction between the first wall/blanket structural material and candidate breeding-heat transport materials is discussed along with interaction between magnetic fields used for plasma confinement and electrically conductive breeding-heat transport liquids

S D

A78-44108 * Hydrogen attack - Influence of hydrogen sulfide D Eliezer and H G Nelson (NASA Ames Research Center, Moffett Field, Calif.). *National Association of Corrosion Engineers, International Corrosion Forum Devoted Exclusively to the Protection and Performance of Materials, Houston, Tex., Mar 6-10, 1978, Paper 9 p 9 refs*

An experimental study is conducted on 12.5-mm-thick SAE 1020 steel (plain carbon steel) plate to assess hydrogen attack at room temperature after specimen exposure at 525 C to hydrogen and a blend of hydrogen sulfide and hydrogen at a pressure of 3.5 MN/sq m for exposure times up to 240 hr. The results are discussed in terms of tensile properties, fissure formation, and surface scales. It is shown that hydrogen attack from a high-purity hydrogen environment is severe, with the formation of numerous methane fissures and bubbles along with a significant reduction in the room-temperature tensile yield and ultimate strengths. However, no hydrogen attack is observed in the hydrogen/hydrogen sulfide blend environment, i.e., no fissure or bubble formation occurred and the room-temperature tensile properties remained unchanged. It is suggested that the observed porous discontinuous scale of FeS acts as a barrier to hydrogen entry, thus reducing its effective equilibrium solubility in the iron lattice. Therefore, hydrogen attack should not occur in pressure-vessel steels used in many coal gasification processes. S D

A78-44109 Liquid metal cooling concepts in solar power application P B Deegan, J D Mangus, and G A Whitlow (Westinghouse Electric Corp., Advanced Reactors Div., Madison, Pa.). *National Association of Corrosion Engineers, International Corrosion Forum Devoted Exclusively to the Protection and Performance of Materials, Houston, Tex., Mar 6-10, 1978, Paper 15 p 7 refs.*

The paper evaluates the application of liquid-sodium cooling to solar thermal power plant with appropriate comparisons with other proposed coolant fluids. It is shown that the thermodynamic and thermophysical properties as well as the proven technology of a liquid sodium heat transport system provide numerous advantages and benefits for application to a central receiver solar thermal power plant concept. Major advantages are (1) attainment of high thermodynamic-cycle efficiencies, (2) reduced relative costs, and (3) realization of the system concept by the mid-1980s through the use of proven liquid-metal technology developed in the power industry, without recourse to extensive development programs. The overall plant net efficiency is predicted to approach 40% for either storage or receiver operation, which is beneficial for the size, cost and design of pertinent subsystems. S D

A78-44112 Liquid metal requirements for inertial confinement fusion. W R Meier and J A Maniscalco (California, University, Livermore, Calif.). *National Association of Corrosion Engineers, International Corrosion Forum Devoted Exclusively to the Protection and Performance of Materials, Houston, Tex., Mar 6-10, 1978, Paper 21 p 22 refs* Contract No W 7405-eng-48

The paper surveys and evaluates the possible applications of liquid metals in laser inertial confinement fusion power plants and describes a particular laser fusion reactor concept that uses liquid lithium for first-wall and blanket structure protection, tritium breeding, and heat removal. The absence of magnetic fields makes it easier to use liquid metals as coolants, and the lower fusion chamber vacuum requirements make it possible to consider liquid metals as first-wall and blanket structure protectors. Lead, sodium, and lithium are compared in performing these three functions, and lithium is shown to adequately fulfill all the functions. Lithium also serves for tritium breeding. The liquid-lithium waterfall reactor is presented as a concept in which liquid lithium acts as the coolant, tritium breeder, and first-wall and blanket structure protector. S D

A78-44119 Evaluation of the efficiency of a device which uses solar energy to apply thermal shocks to gas (Evaluation de l'efficacité d'un dispositif permettant de réaliser des chocs thermiques sur des gaz par concentration d'énergie solaire) J Lede, C Weber, and J Villermaux (CNRS, Laboratoire des Sciences du Génie

Chimique, Nancy, France) *Académie des Sciences (Paris), Comptes Rendus, Serie B - Sciences Physiques*, vol 286, no 22, June 5, 1978, p 299-302. 5 refs. In French.

The thermal shock device described uses a conical injector nozzle as an absorbing cavity for concentrated solar energy. Experiments with methane are reported, the gas flowing rapidly through the nozzle is heated to nearly 1700 K by the walls which are nearly 2500 K. The methane was very rapidly chilled by contact with jets of cold argon gas in a reaction chamber. Four jets of argon assure complete mixing. Two methods in conjunction with two models are used to analyze the results and determine the rate of heating. One method involves solution of heat equations and the other method is concerned with the amount of acetylene formed. Both methods indicate that the methane is heated in the order of 1,000,000 deg/s. M L

A78-44122 Energy analysis, energy quality, and environment. H T Odum (Florida, University, Gainesville, Fla.). In *Energy analysis. A new public policy tool* Boulder, Colo., Westview Press, Inc. (AAAS Selected Symposia Series, No 9), 1978, p 54-87. 13 refs. Research supported by the National Research Council, Contract No E(40-1)-4398.

The paper describes methods of energy analysis used to characterize the energetics of man and the biosphere and to evaluate alternative choices in energy utilization. The basic energy diagram and the preparation of relevant data are explained, energy quality, its evaluation, and its significance as a value measure are considered, concepts of energy cost and energy quality are presented, and the application of these concepts to natural and economic systems as well as to alternatives of special interest in energy policy-making are discussed. M L

A78-44123 Energy analysis and energy RD&D - Planning and decisionmaking. R H Williamson (U.S. Department of Energy, Office of the Assistant Administrator for Planning, Analysis and Evaluation, Washington, D.C.). In *Energy analysis. A new public policy tool* Boulder, Colo., Westview Press, Inc. (AAAS Selected Symposia Series, No 9), 1978, p 88-96.

The paper presents a status report on what ERDA has done in the way of net energy analyses, summarizes the energy analysis procedures and guidelines used within ERDA, reports a few insights and findings from ERDA's current work, and discusses how ERDA is currently progressing towards the use of net energy analysis in decision-making. The goals of the ERDA net energy analysis are to obtain an initial energy analysis for each of the generic technologies under consideration, to improve the definitional and computational aspects of net energy analysis, and to establish some uniform guidelines for the sake of compatibility. M L

A78-44149 Geothermal perturbations on the atmospheric environment. R E Kelly (Mississippi, University, University, Miss.). *Geothermal Energy*, vol 6, June 1978, p 19-24. 9 refs. Contract No W-7405-eng-48.

A simple but not precise procedure for using existing meteorological data to predict air quality changes due to geothermal sources is explained. Since geothermal sources emit large amounts of water vapor and heat, the procedure is concerned with predicting changes in relative humidity and temperature. Modifications caused by atmospheric inversions and nonzero stack heights are examined, and the effects of particulate settling, chemical reactions, and radioactive decay are studied. The statistical Gaussian equation for dispersion is applied in the mathematical method used to calculate pollution concentration as well as temperature and relative humidity changes by an emitted plume. The procedure is used to predict characteristics of Imperial Valley, California, installations. M L

A78-44150 The effect of the Broadlands Geothermal Power Scheme on the Waikato River. D J Willis (New Zealand Electricity Department, Power Station Siting Section, New Zealand). *Geothermal Energy*, vol 6, June 1978, p 25-34. 6 refs.

The Broadlands Geothermal Power Scheme which, in its first full year of operation is planned to provide 3% of the total energy

generated in New Zealand, is described, and procedures for disposing of the hot and chemical-laden bore water without damaging the Waikato River are considered. Characteristics of the Waikato River and of the bore water are reported. Since river temperature increases that would result from open cycle condenser cooling are unacceptable, condenser cooling alternatives are examined, and the use of mechanical draft cooling towers is found to be most suitable. While chemical procedures for reducing ammonia and arsenic ion levels in the bore water could be established, the problem is obviated by injecting waste bore water directly into the ground, this is the recommended method for disposal. M L

A78-44192 A graphical approach to determine the economics of recovering resources from municipal solid waste. J G Abert and R M Vancil (National Center for Resource Recovery, Inc., Washington, D C). *Conservation and Recycling*, vol 1, no 3-4, 1977, p 299-314. 43 refs

A rough determination of the economic feasibility of resource recovery as a substitute in whole or in part for traditional forms of solid waste disposal may be all that is necessary for a community to embark on a course leading to the construction of a facility, or to show a lack of economic viability in particular circumstances. Often, feasibility studies are commissioned which result in rather large expenditures of time and money. The purpose of this paper is to offer a convenient method of evaluating recovery potential, given a set of initial and locally determined inputs. The evaluative tool is a graphic device which combines in the form of a nomograph the pertinent cost and revenue relationships. The device answers the question as to whether recovery is economically competitive with the alternatives for solid waste disposal. Put differently, the device will help decide whether recovery is likely to increase or decrease costs. (Author)

A78-44197 # The effect of fuel consumption on cost developments (Der Einfluss des Kraftstoffverbrauchs auf die Kostenentwicklung). B Glockner (Gesellschaft für Internationalen Flugverkehr mbH, Berlin, East Germany). *Technisch-ökonomische Information der zivilen Luftfahrt*, vol 14, no 2, 1978, p 80-83. In German

In connection with the trends of increasing fuel costs, approaches for reducing fuel consumption have become very important for the profitability of airline operations. The introduction of new directions for refueling in conjunction with an adherence to favorable flight regimes has made it possible for INTERFLUG, the airline of the German Democratic Republic, to save huge amounts of fuels without violating the requirements of flight safety. An investigation is conducted regarding the connection between fuel consumption and cost developments. Differences in the fuel prices of different countries are one of several factors which make it difficult to optimize costs. The cost of fuel as a part of the flight-time related expenses depends to a very large extent on the route of the aircraft. In the case of great price differences, it is customary to obtain additional fuel at places where the prices are low. The transportation of a greater amount of fuel, on the other hand, leads to a greater fuel consumption, which has also to be taken into consideration. Aspects of fuel consumption in relation to air route and flight time are studied and costs which depend on the time of flight are considered. G R.

A78-44220 Voltage transformers for solar elements (Spannungswandler für Solarelemente). N Rohde (Neurologische Universitätsklinik, Düsseldorf, West Germany). *Elektronik*, vol 27, July 1978, p 76-78. 7 refs. In German

The design of solar generators must be based on the voltage provided by the individual element. This voltage does not exceed a value of 0.5 V. Approaches involving a voltage transformation with the aid of germanium transistors were used to avoid series combination of many elements. The introduction of field-effect power transistors has improved conditions significantly. Certain limitations are related to the voltage level required for the control of the field-effect power transistors. The design of self-starting transformers

appears, therefore, difficult. However, the solar generator employs generally a buffer which provides energy during darkness. Attention is given to the control of the transformer device in connection with an operation during the times at which sufficient light is available, taking into account design details involving the use of a photovoltaic cell. G R

A78-44222 Silicon solar cells in appliances and installations (Silizium-Solarzellen in Gebrauchsgerten und Anlagen). P Kipp (Ferranti GmbH, Munich, West Germany). *Elektronik*, vol 27, July 1978, p 95-99. In German

The use of silicon solar cells in devices and installations with power requirements of several watts is considered, taking into account, in addition to a use of solar radiation, also a utilization of artificial light sources, such as incandescent and fluorescent lamps. The spectral sensitivity of silicon cells is compared with the spectral energy distributions of solar radiation, the light of an incandescent lamp, and the light of a fluorescent lamp. The determination of the required dimensions for a solar generator is illustrated with the aid of an example involving the design of a solar generator for a 100 W radio relay station. Applications of the considered solar generators are related to radio beacons mounted on a buoy, a mobile receiving station, a portable generator for a daily electrical energy consumption of 3 Ah, a mobile home, a large clock, and a flashlight. G R

A78-44226 A solar airship - More than a flight of fancy. G Khoury (Imperial College of Science and Technology, London, England) and E Mowforth (Surrey University, Guildford, England). *New Scientist*, vol 79, July 13, 1978, p 100-102

The development of a solar-powered aircraft is considered. The design consists of an aircraft carrying an array of solar cells over most of its surface. The cells represent a weight of approximately one third of the overall envelope. A 20% efficiency in energy conversion is expected along with an airspeed of over 100 km/h for over six hours during the day. Potential energy storage systems include the use of electrolysis to produce hydrogen which would be stored in pods and used to fuel gas turbines. S C S

A78-44333 # Solar water heater using heat pipes (Solnechnyyi vodonagrevatel' na osnove teplovykh trubok). O Mukhammetdurdyeva, R Baimov, and K Toiliyev (Turkmenkii Gosudarstvennyi Universitet, Ashkhabad, Turkmen SSR). *Akademika Nauk Turkmenkoi SSR, Izvestia, Seria Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk*, no 2, 1978, p 111-113. In Russian

A solar water heater is described, the heat receiving part of which consists of two heat pipes in a copper container 82 cm in length and with an outer diameter of 17 mm. Twenty Duralumin plates measuring 8 x 8 cm are soldered onto the heated portions of the heat pipes in order to increase the useful area. The heated part of the pipes is located in a box measuring 65 x 21.5 x 10.5 cm made of 2-cm-thick boards. The insulating material is covered by aluminum foil. By the use of heat pipes, not all of the heated water is contained in the box, so that heat losses through the transparent coating are reduced. Lower working temperatures can be used, since the heat pipes can transfer heat at low temperature gradients between the evaporation and condensation zones. Tests showed the heat-pipe water heater to be as effective as conventional ones. P T H

A78-44334 # Analysis of the effect of mismatch of thermal battery parameters and external factors on the operation of a solar thermoelectric generator (Analiz vlianiya rassoglasovaniya parametrov termobatarei i vneshnikh faktorov na rezhim raboty solnechnogo termoelektrogeneratora /STEG/). Ch Agabaev, O Annaev, S Khandovletov, and A Charykuliev (Akademika Nauk Turkmenkoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR). *Akademika Nauk Turkmenkoi SSR, Izvestia, Seria Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk*, no 2, 1978, p 113-115. In Russian

A78-44429 Comparative calculations for thin-film and bulk single-crystal Schottky-barrier solar cells. R J Soukup and L

A Akers (Nebraska, University, Lincoln, Neb.) *Journal of Applied Physics*, vol 49, July 1978, p 4031-4034 11 refs

A mathematical analysis of the expected short-circuit current density in Schottky-barrier solar cells is presented. For a solar cell with the Schottky barrier on the bottom, back illuminated, the active semiconductor material, GaAs for this example, must be a thin film for maximum efficiency. A comparison between this cell and a single-crystal solar cell with the Schottky barrier on the top, front illuminated is made. This comparison shows that solar cells made from polycrystalline films could deliver the same short-circuit current as a single crystal solar cell provided that the minority-carrier diffusion length in the polycrystalline films can be kept to within one order of magnitude lower than that for the single-crystal material. The reason for this is that solar-reflection losses for the back-illuminated thin-film cell can be minimized, while for the front-illuminated single-crystal cell the losses must always be high.

(Author)

A78-44451 # Energy resources - Revisited 1977 W B Haidler (Southwestern Michigan College, Dowagiac, Mich.) *Air University Review*, vol 29, May-June 1978, p 39-50 23 refs.

The energy crisis is presented as being real and immediate. Attention is given to the problem of dwindling reserves of oil and natural gas (especially in the United States), coupled with energy consumption at or above pre-crisis levels (before 1973). It is emphasized that America must rely increasingly on imported oil from politically unstable areas, i.e., the Middle East, and that for the short term, conservation is essential to hold down imports. Alternative sources of energy, e.g., wind, solar, tar sands, and nuclear fusion, are expected to make substantial contributions to the total energy supply beginning only in the period around the turn of the century. Until then, coal and its derivatives (in solid, liquid, and gaseous form) can make up the shortfall if steps are taken now to develop the required technology.

D MW

A78-44472 # Thermoelectric efficiency of some compositions from the $\text{GeTe}_x/\text{x-AgSbTe}_2/1-x$ system S K Decheva and S K Dimitrova (Sofiiski Universitet, Sofia, Bulgaria) *Bulgarian Journal of Physics*, vol 5, no 1, 1978, p 94-100 14 refs

A78-44505 # An aerospace technology developer's perspective T J Kelley (Grumman Aerospace Corp., Bethpage, N.Y.) In *Aerospace technology transfer to the public sector*, Proceedings of the Conference, Crystal City, Va., November 9-11, 1977.

New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p 20-25

Various contributions of the Grumman Aerospace Corporation to the public sector are discussed with reference to their origins in high technology programs and their present use in everyday applications. Among the items mentioned are aluminum canoes and truck bodies, windmills for electricity generation, solar collectors for homes, and advanced firefighting equipment, e.g., a radio-controlled nozzle pump, and lighter, more flexible protective clothing for firefighters.

D MW

A78-44535 Nonequilibrium processes under conditions of T-layer formation. S S Katsnel'son and V S Slavin (Akademiia Nauk SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR) (*Teplofizika Vysokikh Temperatur*, vol 15, Sept-Oct 1977, p 1064-1070) *High Temperature*, vol 15, no 5, Mar 1978, p 899-905 9 refs Translation

The complete system of one dimensional MHD equations is solved in the two-temperature plasma approximation for the formation of a current sheet in a rare-gas plasma flow with a nonuniformly distributed alkali-metal impurity. It is shown that nonequilibrium processes, leading to the detachment of electron temperature, have a significant effect on the dynamics of current sheet formation, and this formation is initiated at the moment of establishment of ionization equilibrium. The theoretical analysis is compared with experimental data on a flow of helium (with initial parameters of 3.2 atm, 3.3 km/sec and 1040 K) in an MHD generator channel. It is

noted that the current sheet effect can be used to raise the energy conversion efficiency of an MHD generator.

B J

A78-44536 Method for taking account of the effect of chemical kinetics on the thermodynamic properties of the working body in supersonic MHD generators N M Prusova and N N Pshenichnov (Akademiia Nauk SSSR, Energeticheskii Institut Irkutsk, USSR) (*Teplofizika Vysokikh Temperatur*, vol 15, Sept-Oct 1977, p 1071-1076) *High Temperature*, vol 15, no 5, Mar 1978, p 905-910 23 refs Translation

A78-44537 Indian experimental MHD unit V R Ramaprasad (Indian Company for Heavy Electrical Equipment, Madras, India) (*Teplofizika Vysokikh Temperatur*, vol 15, Sept-Oct 1977, p 1077-1085) *High Temperature*, vol 15, no 5, Mar 1978, p 911-917 15 refs Translation

A review is presented of the Indian MHD energy program with emphasis on a detailed description (schematics are presented) of the U-05 experimental MHD power plant. Consideration is given to coal gasification processes (especially the Lurgi process) as one way to fuel such power plants and to the basic operating parameters of the U-05 plant. Lab and simulation studies in the field of MHD energy are discussed and attention is given to the reduction of nitrogen oxide pollutants as a way to provide raw material for MHD enrichment processes.

B J

A78-44538 Selection of the optimal configuration of the frame and the form of the transverse cross section of a frame-type MHD channel V A Bitiurin and S A Medin (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) (*Teplofizika Vysokikh Temperatur*, vol 15, Sept-Oct 1977, p 1086-1094) *High Temperature*, vol 15, no 5, Mar 1978, p 918-925 6 refs Translation

The variational problem of optimal distribution of current and potential in the cross section plane of a MHD generator channel is solved. In the case of a uniform distribution of velocity and a two-dimensional nonuniformity of distribution of conductivity, the potential distribution on the walls of the optimal channel is linear, i.e., the walls are formed of flat conducting frames. A numerical solution of the direct problem of electrodynamics is used to investigate the effect of the cross section shape of the channel with flat frames on its characteristics. It is shown that channels of elliptical (or circular) cross section are more efficient than channels of rectangular cross section.

B J

A78-44569 Optical and infrared detectors Edited by R J Keyes (MIT, Lexington, Mass.) Berlin and New York, Springer-Verlag (Topics in Applied Physics Volume 19), 1977 316 p \$39.60

The volume is written for those who desire a comprehensive analysis of the latest developments in infrared detector technology and a basic insight into the fundamental processes which are important to evolving detection techniques. The photon detection process is considered along with thermal detectors, photovoltaic and photoconductive infrared detectors, and photoemissive detectors. Attention is also given to charge transfer devices for infrared imaging and aspects of nonlinear heterodyne detection. Charge-coupled devices and nonlinear photon interactions represent new techniques for extracting more information from weak infrared signals.

G R

A78-44572 Photovoltaic and photoconductive infrared detectors D Long (Honeywell Corporate Research Center, Bloomington, Minn.) In *Optical and infrared detectors*.

Berlin and New York, Springer-Verlag, 1977, p 101-147 88 refs

Photovoltaic and photoconductive infrared detectors offer very high detectivities, although they must often be cooled. The continuing improvement of detector performance is related to the development of highly purified, single-crystal semiconductors as their active materials. Aspects of basic theory are examined, taking into account

direct photon detection, photocurrent, gain, responsivity, noise mechanisms, detectivity, response time, and problems of electrical power dissipation. The important photovoltaic detectors use intrinsic photoexcitation. General relations regarding their theory are discussed. Attention is given to suitable photovoltaic infrared detector material, the theory and the materials used in the case of intrinsic photoconductive detectors, and the characteristics of extrinsic photoconductive detectors. G R

A78-44620 Material research with Spacelab. R. Hostenkamp and J. Lorschiedter. *Dornier-Post* (English Edition), no. 2, 1978, p. 54-58.

The materials laboratory in the European Spacelab utilization program will permit experimentation at virtually zero gravity in the fields of metals, laminated materials, glasses, ceramics, and semiconductors. The equipment includes a central control console, consisting of a computer system, a peripheral unit, and a data acquisition system. The central experimental facility is the mirror heating facility, designed primarily for liquid and gas zone pulling of crystals. The mirror furnace uses the geometrical characteristics of an enclosed ellipse of rotation to heat a sample positioned at one focus point by a lamp at the second focus. Details on the operation of this unit are given. P T H

A78-44752 Efficient amplification of a discharge-pumped KrF laser. S. Watanabe, S. Shiratori, T. Sato, and H. Kashiwagi (Ministry of International Trade and Industry, Electrotechnical Laboratory, Tanashi, Tokyo, Japan). *Applied Physics Letters*, vol. 33, July 15, 1978, p. 141-143. 6 refs.

An output energy of 0.75 J has been obtained with a pulse width of 40 ns and an efficiency of 0.8% by using a UV-preionized KrF amplification system. The stored energy in an amplifier has been improved by a factor of about 1.6 by control of self-breakdown voltage with a change of electrode separation. The measured saturation energy for this device was 51 mJ/sq cm corresponding to a KrF saturation intensity of 1.2 MW/sq cm. The small-signal gain coefficient reached 4.3%/cm at a charging voltage of 35 kV. (Author)

A78-44759 * Emitter current suppression in a high-low-junction emitter solar cell using an oxide-charge-induced electron accumulation layer. A. Neugroschel, F. A. Lindholm, S. C. Pao (Florida, University, Gainesville, Fla.), and J. G. Fossum (Sandia Laboratories, Albuquerque, N. Mex.). *Applied Physics Letters*, vol. 33, July 15, 1978, p. 168-170. 17 refs. Research supported by the U.S. Department of Energy and NASA.

A78-44762 Effects of pinholes, oxide traps, and surface states on MIS solar cells. M. A. Green (New South Wales, University, Kensington, Australia). *Applied Physics Letters*, vol. 33, July 15, 1978, p. 178-180. 16 refs. Research supported by the Utah Foundation and Australian Research Grants Committee.

It is shown that the insulating layer in metal-insulator-semiconductor (MIS) solar cells by no means has to be perfect to obtain optimum photovoltaic performance. Oxide pinhole densities as large as 1000/sq cm can be tolerated without degrading the device properties. Large densities of oxide traps at energies close to the majority-carrier band edge in the semiconductor can reduce the cell efficiency as can surface states in nonoptimal devices. Devices optimally designed with an inversion layer at the IS interface are virtually immune to these states; densities in excess of 10 to the 13th/sq cm causing no degradation in properties. (Author)

A78-44875 Magnetohydrodynamic energy for electric power generation. Edited by R. F. Grundy. Park Ridge, N.J., Noyes Data Corp. (Energy Technology Review Series, Volume 20), 1978. 239 p. 77 refs. \$36.

Aspects of Soviet MHD development are considered along with details concerning open-cycle and closed-cycle MHD studies conducted by American companies. Liquid-metal MHD studies performed by American companies are also discussed, taking into account the selection of parametric study points, the study param-

eters, the LM-MHD/steam binary cycle configuration, assumptions, methodology, the results of a parametric study, cost methodology, MHD duct and magnet costs, liquid-metal pumps and subsystems costs, heat transfer equipment costs, the costs of gas compressors and motor drives, steam turbine/generator costs, the sizing and cost algorithm computer program, component installation costs, a comparison of the cost of electricity for a LM-MHD/steam binary power plant, and aspects of cycle description. Hydrogen-oxygen combustion powered steam MHD systems are also examined. G R

A78-44988 # Improving the efficiency of high-temperature power plants (O povyshenii effektivnosti vysokotemperaturnykh energeticheskikh ustanovok). N. A. Minailenko (Akademiia Nauk Ukrainskoi SSR, Institut Tekhnicheskoi Teplofiziki, Kiev, Ukrainian SSR). *Teplofizika i Teplotekhnika*, no. 35, 1978, p. 59-63. 5 refs. In Russian.

It is proposed that the efficiency of high-temperature power plants (i.e., conventional and nuclear gas-turbine plants) can be improved by intensifying radiative heat transfer in heat exchanger channels. This can be done by increasing the absorptivity of the heat-carrying fluid (e.g., helium) through the addition of optimal (minimal) concentrations of minute (0.1-3 microns) graphite particles. A heat-carrying fluid with a minimum concentration of graphite particles is practically a clean gas, which assures reliability operation of the plant. B J

A78-45076 The environment today. R. E. Train (World Wildlife Fund, Washington, D.C.). *Science*, vol. 201, July 28, 1978, p. 320-324.

Consideration is given to various aspects of current environmental research noting energy conservation programs associated with space heating and cooling, automobiles, the industrial cogeneration of steam and electricity, and commercial lighting. Efforts aimed at environmental protection are reviewed with reference to the Clean Air Act, the national energy policy, and the planned World Climate Conference. Water quality projects are described such as waste-treatment procedures for municipal and industrial wastes. The 1976 Toxic Substances Control Act is discussed and prospects for a worldwide system to protect representative ecosystems are presented. S C S

A78-45090 Urban fuel economy - An alternate interpretation of recent computer simulation calculations. L. Evans and R. Herman (GM Research Laboratories, Warren, Mich.). *Transportation Research*, vol. 12, June 1978, p. 163-165. 7 refs.

Estimates of the effect of different traffic control scenarios on vehicular fuel consumption in an urban network were obtained in a recent report using detailed computer simulation. In the present work it is shown that these computer simulation results are consistent with a previously developed model of fuel consumption in urban traffic systems derived by conducting experiments in street traffic. (Author)

A78-45097 * # Fuel consumption improvement in current transport engines. R. W. Hines (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, Conn.) and J. A. Ziemanski (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Joint Propulsion Conference, 14th, Las Vegas, Nev., July 25-27, 1978, AIAA Paper 78-930*. 7 p. 7 refs. Contracts No. NAS3-20630, No. NAS3-20632.

A review is conducted of improvements which can be made with respect to the fuel consumption of current engines and new production versions of current engines. A description is presented of an engine diagnostics program which has the objective to identify and quantify the causes and sources of performance deterioration in the JT9D turbofan engine and to develop basic data which will be applied to minimize performance degradation of current and future engines. General areas where performance losses occur are examined, taking into account seals, blades and vanes, and cases. Potential performance improvement concepts are related to improved compo-

nent aerodynamics, improved flowpath sealing, blade tip clearance control, improved turbine cooling effectiveness, improved turbine materials and coatings, duct and nozzle aerodynamic refinements, nacelle aerodynamic refinements, forced exhaust mixers, advanced nacelle materials, and advanced fuel control G R

A78-45098 * # NASA/General Electric Engine Component Improvement Program A J Albright, D J Lennard (General Electric Co., Cincinnati, Ohio), and J A Ziemianski (NASA, Lewis Research Center, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Joint Propulsion Conference, 14th, Las Vegas, Nev., July 25-27, 1978, AIAA Paper 78-929* 7 p Contracts No NAS3-20629, No NAS3-20631

The Engine Component Improvement (ECI) Program has been initiated in connection with projects designed to reduce the impact of the world-wide energy crisis in the area of aviation. The two parts of the ECI program have the overall objective to identify and quantify the sources and causes of CF6 engine performance deterioration, and to reduce the fuel consumption of CF6 engines through the development and the incorporation of various performance improvement concepts. The CF6 high-bypass turbofan engine was selected as a basis for this effort, since it is expected to be a significant fuel user in commercial revenue service for the next 15 to 20 years. The first part of the ECI program represents the initial step in an effort to achieve a goal of five percent reduction in fuel usage for CF6 engines in the 1979-82 time period. The first performance improvement concept selected is an improved efficiency fan blade. Other improvements are related to a short core exhaust system and an improved high pressure turbine G R

A78-45135 # The slagging MHD generator - A parametric study J G Taylor (Sandia Laboratories, Albuquerque, N Mex.), *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 11th, Seattle, Wash., July 10-12, 1978, Paper 78-1174* 11 p 11 refs Research supported by the U S Department of Energy

A coal combustion MHD generator is examined to determine the influence of a liquid slag layer which coats the electrode walls. The slag layer is formed by vapor condensation from the gas stream and maintained in equilibrium by shear flow along the wall. Boundary layer theory is applied to give a self-consistent analysis of the core flow, gas phase boundary layer, and liquid slag layer (Author)

A78-45136 * # High temperature solar photon engines A Hertzberg, R Decher, A T Mattick (Washington, University, Seattle, Wash.), and C V Lau (Boeing Commercial Airplane Co., Seattle, Wash.) *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 11th, Seattle, Wash., July 10-12, 1978, Paper 78-1177* 32 p 30 refs Grant No NGL-49-002-044

High temperature heat engines designed to make maximum use of the thermodynamic potential of concentrated solar radiation are described. Plasmas between 2000 K and 4000 K can be achieved by volumetric absorption of radiation in alkali metal vapors, leading to thermal efficiencies up to 75% for terrestrial solar power plants and up to 50% for space power plants. Two machines capable of expanding hot plasmas using practical technology are discussed. A binary Rankine cycle uses fluid mechanical energy transfer in a device known as the 'Comprex' or 'energy exchanger'. The second machine utilizes magnetohydrodynamics in a Brayton cycle for space applications. Absorption of solar energy and plasma radiation losses are investigated for a solar superheater using potassium vapor (Author)

A78-45215 To bed betimes W Patterson (Friends of the Earth, Ltd., London, England) *New Scientist*, vol 79, July 20, 1978, p 180, 181

Fluidized bed combustion (which usually takes place at temperatures between 700 and 900 C) is discussed with reference to its potential for energy production in coal-fired systems. It is noted that

even high-sulfur coal may be used without danger to the environment, because the sulfur combines with calcium in the limestone or dolomite ash in the bed to form a precipitate of calcium sulfate. Two types of fluidized beds are described: one which operates at ambient pressure, another which operates at pressures of ten atmospheres or more. Fluidized bed boilers are already in operation, e.g., a 25 MW plant outside Enköping, Sweden, which supplies the town's heating system, with other larger (up to 200 MW) plants either under construction or in the design stage D M W

A78-45245 Wave interaction in a beam-plasma system in presence of dispersion and higher order non-linear effects M Lisak (EURATOM and Chalmers University of Technology, Institute for Electromagnetic Field Theory, Goteborg, Sweden) *Physica Scripta*, vol 17, June 1978, p 577-581 11 refs

The third-order perturbation theory based on the method of multiple scales is applied in order to describe wave interactions in a beam-plasma system. The formalism includes simultaneous effects of dispersion and nonlinearities giving rise to self and mutual interactions. Some traveling wave solutions are obtained in special cases of physical interest (Author)

A78-45251 A practical method for determining wind frequency distributions for the lowest 200 m from routine meteorological data A-S Smedman-Hogstrom and U Hogstrom (Uppsala, Universitet, Uppsala, Sweden) *Journal of Applied Meteorology*, vol 17, July 1978, p 942-954 8 refs Research supported by the National Board for Energy Source Development

A simple model is described which in a crude way considers the effects of variation of terrain characteristics and of stability on the wind profile in the lowest 100 or 200 m of the atmosphere. The model is not primarily intended for giving exact individual profiles but rather for producing statistics of wind speeds at levels in the height range below, say, 200 m. The study is concerned with rural conditions only. The input to the model is routine meteorological data and detailed information on the roughness characteristics as a function of distance and direction relative to the measuring point. The results suggest that the general approach of describing the wind profile in the various internal boundary layers as power laws with exponents characteristic of the origin of the respective boundary layers is basically valid S D

A78-45321 CO2 and spaceship earth S Terra *EPRI Journal*, vol 3, July-Aug 1978, p 22-27

Carbon dioxide concentration in the atmosphere has been steadily increasing (from an estimated 293 ppm before 1860 to about 334 ppm in 1977). Mainly responsible for the increase is the burning of coal, oil, and natural gas as fuel in industrial and commercial applications. It is suggested that the elevated levels of atmospheric CO2 may be leading to a global warming on the order of 2-3 C, a 2% increase in average relative humidity, and 7% higher average rainfall. It is also suggested that the world's forests may be a source rather than a sink for CO2. Scenarios range from a disastrous 5 m rise in the mean sea level, resulting from the melting of the polar caps, to a simple shift of rainfall patterns toward the more populated areas of the northern hemisphere, thus opening up previously arid areas to agriculture and settlement D M W

A78-45365 High-efficiency p(+)-n-n(+)-back-surface-field silicon solar cells J G Fossum and E L Burgess (Sandia Laboratories, Albuquerque, N Mex.) *Applied Physics Letters*, vol 33, Aug 1, 1978, p 238-240 9 refs Research supported by the U S Department of Energy

The design and fabrication of high-efficiency p(+)-n-n(+) back-surface-field silicon solar cells are described. The fabrication process has been developed to yield maximum attainable carrier lifetimes (about 0.7 msec) in the base region of the cell, thereby allowing the back n-n(+) junction to enhance effectively the cell performance. A surprising conclusion drawn from a study of the device physics supporting the experimental development of the cell is that the

front-surface recombination velocity controls the recombination in the emitter. That is, the bulk p(+) emitter is 'transparent' to minority-carrier (electron) flow. The recognition of the significance of the front silicon surface has led to process modifications that result in improvements in both the short-circuit current density and the open-circuit voltage of the cell. With these improvements, the cells exhibit AM1 conversion efficiencies of nearly 17%. The fabrication process is reliable and reproducible with exceptionally high yield. (Author)

A78-45435 * # Medium power voltage multipliers with a large number of stages. W. T. Harrigill and I. T. Myers (NASA, Lewis Research Center, Cleveland, Ohio) *Institute of Electrical and Electronics Engineers, Power Electronics Specialists Conference, Syracuse, N.Y., June 13-15, 1978, Paper 7* p. 13 refs.

Voltage multiplier techniques were extended at medium power levels to larger multiplication ratios. A series of DC-DC converters were built, with from 20 to 45 stages and with power levels up to 100 watts. Maximum output voltages were about 10,000 volts.

(Author)

A78-45453 Thermal regimes in a primary fluid heated by solar energy in a linear collector. O. Barra, M. Conti, L. Corraja, R. Visentin, and E. P. Caratelli (Calabria, Università, Cosenza, Italy) *Nuovo Cimento, Sezione C*, vol. 1 C, Mar.-Apr. 1978, p. 167-184. 15 refs.

The steady-state heat transfer equation has been solved for the determination of temperature profiles in a diathermic oil flowing through a linear boiler placed on the focal line of cylindrical parabolic solar concentrators. Finite-difference methods have been employed to solve the equation, by assuming Nikuradse velocity profiles and available experimental data to supply boundary conditions and to estimate equation parameters. A set of solutions for several physical and geometrical situations is shown and discussed in order to give useful indications on the design of solar power plant.

(Author)

A78-45454 Transient temperature variations in the primary network of a solar power plant. O. Barra, M. Conti, L. Corraja, R. Visentin, and V. Marinelli (Calabria, Università, Cosenza, Italy) *Nuovo Cimento, Sezione C*, vol. 1 C, Mar.-Apr. 1978, p. 185-195. 6 refs.

The energy conservation equations are solved to determine the transient behavior of a solar power plant, made of linear concentrators. The equations are solved by the finite-difference method, assuming typical project parameters and the available experimental data. Different physical and geometrical configurations are considered, the results are shown and discussed in order to supply useful indications for the design of a solar power plant. (Author)

A78-45468 Conditions for near-electrode contraction of a discharge in a combustion-product plasma. A. M. Virnik, N. M. Zykova, T. S. Kurakina, and E. V. Mel'nikov (Akademiya Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) *(Teplofizika Vysokikh Temperatur, vol. 15, Nov. Dec. 1977, p. 1148-1151)* *High Temperature*, vol. 15, no. 6, May 1978, p. 982-986. 12 refs. Translation.

The experiments described were carried out to study the processes occurring at the electrodes of an MHD power generator during the transition from a diffuse to a constricted discharge. The tests were performed with laboratory equipments simulating a combustion product plasma in a space charge layer (flow temperature of 2600 K, conductivity of 1.5 to 9 mho/m). The threshold current density of a diffuse discharge is plotted against the anode temperature and the plasma conductivity. V. P.

A78-45654 Electron heating in channel of nonequilibrium magnetohydrodynamic generators. N. A. Kruzhilin (Akademiya Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) *(Teplofizika Vysokikh Temperatur, vol. 15, Nov. Dec. 1977, p. 1262-1268)* *High Temperature*, vol. 15, no. 6, May 1978, p. 1082-1088. 21 refs. Translation.

In the present paper, available theoretical and experimental data on the properties of discharges in a strong magnetic field are used as a basis to arrive at certain conclusions concerning the calculation of the electron temperature in the channel of a Faraday MHD generator of nonuniform conductivity. It is shown that to calculate Joule dissipation in the channel, it is imperative to take into consideration such experimentally observed phenomena as ionization turbulence and the presence of a mean Hall current. V. P.

A78-45655 Near-cathode region of constricted discharge at MHD-generator metallic electrodes. I. I. Beilis (Akademiya Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) *(Teplofizika Vysokikh Temperatur, vol. 15, Nov. Dec. 1977, p. 1269-1275)* *High Temperature*, vol. 15, no. 6, May 1978, p. 1088-1094. 21 refs. Translation.

The parameters of an arc-discharge spot are studied with allowance of the processes in the cathode plasma, on the basis of a mathematical model that takes into consideration the presence of a film on the electrode surface. It is shown that at mean electrode temperatures above 900 K, the current density in the spot decreases markedly while the spot temperature is hardly affected. An electrode erosion mechanism associated with melting and evaporation of the electrode metal is proposed. The phenomenon of constricted discharge is analyzed for high electrode temperatures. It is shown that for cathode spot parameters characteristic of MHD generators, the arc discharge at a steel electrode (contrary to that at a copper electrode) is thermally unsteady. V. P.

A78-45656 Switching of electrodes in the end zone of a series MHD generator. G. P. Bazarov, E. N. Kufa, and S. A. Medin (Voronezhskii Politehnicheskii Institut, Voronezh, Akademiya Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) *(Teplofizika Vysokikh Temperatur, vol. 15, Nov. Dec. 1977, p. 1276-1283)* *High Temperature*, vol. 15, no. 6, May 1978, p. 1094-1100. 8 refs. Translation.

The influence of the technique of commutating segmented electrodes at the end sections of an MHD channel on the local and integrated characteristics of the power generator is studied. A numerical solution is obtained to the two-dimensional electro-dynamics problem for the end section of a channel carrying a homogeneous flow. An analysis of the integrated characteristics shows that maximum energy conversion efficiency is achieved when short-circuited segmented electrodes are commutated at small angles. The current and potential distributions at the contact of a solid electrode are examined, showing that for any commutation technique, there exists a contact arrangement that eliminates current and voltage buildup at a contact. V. P.

A78-45657 Investigation of the temperature dependence of the electrical conductivity of the working fluid of large MHD generators. N. A. Balashov, I. A. Vasil'eva, I. M. Gaponov, G. P. Maliuzhonok, A. P. Nefedov, V. B. Novosadov, F. M. Oberman, L. P. Proberzhskii, and E. M. Shelkov (Akademiya Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) *(Teplofizika Vysokikh Temperatur, vol. 15, Nov.-Dec. 1977, p. 1284-1293)* *High Temperature*, vol. 15, no. 6, May 1978, p. 1101-1110. 15 refs. Translation.

The paper deals with the results of a joint Soviet-American experiment which was carried out to measure the dependence of the electrical conductivity of the plasma of an open-cycle MHD generator on the temperature, the plasma pressure, the degree of oxygen enrichment, and the amount of ionizable addition. The U-25 and the AVCO Mark VI facilities employed in the experiments are described, along with the respective procedures. An approximate expression is derived which does not require a computer to calculate the electron density, electron mobility, and the electrical con-

ductivity of the combustion-product plasma over the entire range of working-fluid parameters V P

A78-45658 Appearance of interelectrode arcs and electric fluctuations in an MHD channel V I Kovbasiuk, N N Baranov, A D Iserov, and I I Klimovskii (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) (*Teplofizika Vysokikh Temperatur*, vol 15, Nov-Dec 1977, p 1294-1302) *High Temperature*, vol 15, no 6, May 1978, p 1110-1118 21 refs Translation

In the experiments described, the conditions leading to the onset of Hall (electrode) arcs in diagonal MHD channels were studied by recording and analyzing the fluctuations of the electrode potentials. The experiments were carried out with the U-25 facility, employing induced electric fields. It is shown that the onset of Hall arcs (breakdowns) in an induced electric field is accompanied by the onset of high-frequency (on the order of 100 kHz) noise in the spectrum of electrode voltage fluctuations, and that the moment of onset of Hall arcs depends strongly on the Faraday currents to the electrodes and on the magnetic field induction V P

A78-45661 Efficiency of a pulsed Faraday MHD generator in a scheme with a thermonuclear reactor V V Breev, V P Panchenko, and V V Chernukha (Akademiia Nauk SSSR, Institut Atomnoi Energii, Moscow, USSR) (*Teplofizika Vysokikh Temperatur*, vol 15, Nov-Dec 1977, p 1321-1323) *High Temperature*, vol 15, no 6, May 1978, p 1140-1142 Translation

The plasma-generating energy storage system examined in the present paper is composed of a pulsed MHD power generator and a pulsed thermonuclear reactor. The system is quasi-stationary in the sense that its parameters vary in time. The problem of defining the optimal configuration of the MHD channel and the optimal mode of operation is discussed, evaluating the efficiency of the system in terms of the ratio of the electric energy generated to the thermal energy of the source. The pressure, total temperature, current voltage characteristic, and effective conductance at the channel inlet are plotted vs time. It is shown that for operation at an active load the system efficiency may approach 30 percent V P

A78-45735 Performance analysis and cost optimization of a solar-assisted heat pump system J W MacArthur (Honeywell Energy Resources Center, Minneapolis, Minn), W J Palm, and R C Lessmann (Rhode Island University, Kingston, RI) *Solar Energy*, vol 21, no 1, 1978, p 1-9 16 refs

A solar-assisted heat pump system with a conventional backup unit was simulated for a 93-sq-m (1000-sq-ft) house in Rhode Island using quasi-dynamic computer models. The performance of the system as a function of collector area and thermal storage volume was evaluated to determine the fraction of the space heating and domestic hot water load that was supplied by the solar-assisted system. This information was used to compute the payback time, based on cumulative costs, for each variation of the system's parameters when compared to a conventional system. The optimal combination of system components which had a payback time less than the mortgage life was determined. For the given initial costs of solar panels and storage reservoir, this optimal combination was found to be insensitive to the variations in mortgage and fuel cost growth rates presented in this report (Author)

A78-45736 The result of cooling operation of Yazaki Experimental Solar House 'One' T Ishibashi (Yazaki Buhin Co., Ltd, Kosai, Shizuoka, Japan) *Solar Energy*, vol 21, no 1, 1978, p 11-16

The testing of a solar cooling system for a 127-sq-m residence is described. The refrigerating unit is a 6000 kcal/hr compact water lithium bromide absorption unit, the solar collector, heat storage tank, fan coil unit, floor panel heating, cooling tower, and four pumps are characterized, and the Yazaki experimental house design is reported. Data on the relation of total insolation to produced energy, cooling load, temperature parameters, and solar utilization

are presented, and the data are discussed with reference to the design of solar cooling systems for houses M L

A78-45737 Absorption of solar radiation in ponds. R Viskanta (Purdue University, West Lafayette, Ind) and J S Toor (Science Applications, Inc., La Jolla, Calif) *Solar Energy*, vol 21, no 1, 1978, p 17-25 29 refs

Analysis is presented to predict the local rate of solar energy absorption in a pond using the radiative transfer theory. The physical model considers absorption and scattering by the water and internal reflection of radiation from the air-water interface as well as the bottom. A forward scattering approximation and a discrete-coordinate approximation of the radiative transfer equation are discussed. Numerical results for the local volumetric rate of solar energy absorption in the water are presented in the paper for a range of parameters of physical interest. The effects of the directional distribution of solar radiation incident on the water surface, the attenuation of solar radiation by the atmosphere during the diurnal cycle and the modification of the spectral radiation characteristics of water by impurities and additives on the absorption and distribution of the absorbed energy in the pond are investigated (Author)

A78-45739 PVSS - A photovoltaic system simulation program L H Goldstein and G R Case (Sandia Laboratories, Albuquerque, N Mex) *Solar Energy*, vol 21, no 1, 1978, p 37-43 7 refs

A computer program has been developed to accurately simulate the performance of a photovoltaic system. Sixteen configurations can be simulated, including systems with combinations of battery storage, inverters, d.c.-voltage regulators and maximum power point trackers. Models are presented for system components, and sample runs illustrating various aspects of program performance are described (Author)

A78-45740 A solar-assisted heat pump system for heating and cooling residences B W Tleimat and E D Howe (California University, Berkeley, Calif) *Solar Energy*, vol 21, no 1, 1978, p 45-54 6 refs

It is proposed that heating and cooling of the all-electric residence unit be accomplished by using a solar-assisted heat-pump system. This system would make use of a conventional air-conditioning unit which would be modified by fitting controls to reverse the flow of refrigerant for the heating mode and by changing the outdoor heat exchanger from refrigerant-to-air to refrigerant-to-water. The system would also require a solar collector and two insulated water-storage tanks. The system is described, and the energy output and costs are calculated. It is concluded that the solar-assisted heat-pump system with current fuel prices can provide immediate economic benefit over the all-electric home and is, possibly on par with residences using fuel or liquefied petroleum gas, but would cost more than systems using natural gas M L

A78-45741 Determining typical weather for use in solar energy simulations W R Petrie (Clark University, Worcester, Mass) and M McClintock (Boston University, Boston, Mass) *Solar Energy*, vol 21, no 1, 1978, p 55-59 10 refs

The use of simulation methods to predict the performance of a solar energy system is considered. The paper describes a method of analyzing an optional number of years of weather data for a chosen month resulting in a 'typical week' which is characterized in terms of solar radiation, ambient dry bulb temperature, and wind speed. The 'typical week' is allowed to vary in length between 5 and 10 days in the analysis in order to enable selection of a period that best represents a given month. A comparative computer analysis is used to verify the method; the differences between the averaging method and the 'typical' weather method are less than 7%, and the 'typical' method requires less computer time M L

A78-45742 Eutectic mixtures for solar heat storage N Yoneda and S Takanashi (Tokyo, Science University, Noda, Japan) *Solar Energy*, vol 21, no 1, 1978, p 61-63 11 refs Research supported by the Iwtani Naoki Foundation

Several inorganic eutectic mixtures which have melting points in a range most suitable for solar heat storage and which have high heats of fusion were investigated. Thermodynamic properties of $\text{LiNO}_3\text{-NH}_4\text{NO}_3\text{-NH}_4\text{Cl}$, $\text{LiNO}_3\text{-NH}_4\text{NO}_3\text{-NaNO}_3$, $\text{LiNO}_3\text{-NH}_4\text{NO}_3\text{-KNO}_3$, $\text{Mg(NO}_3)_2\cdot 6\text{H}_2\text{O-MgCl}_2\cdot 6\text{H}_2\text{O}$, and $\text{Mg(NO}_3)_2\cdot 6\text{H}_2\text{O-MgBr}_2\cdot 6\text{H}_2\text{O}$ are reported. Supercooling, corrosion, and other problems associated with practical application of the eutectic mixtures are examined, the heat content of one system is calculated, and the costs per kilojoule are estimated. M I

A78-45743 Units and symbols in solar energy W A Beckman, J A Duffie (Wisconsin, University, Madison, Wis.), J W Bugler (Capricornia Institute of Advanced Education, Rockhampton, Australia), P I Cooper, R V Dunkle (Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia), P E Glaser (Arthur D Little, Inc., Cambridge, Mass.), T Horigome (Ministry of International Trade and Industry, Electrotechnical Laboratory, Tokyo, Japan), T A Lawand (McGill University, Montreal, Canada), E D Howe, and P L Van der Mersch. *Solar Energy*, vol 21, no 1, 1978, p 65-68

The application of SI units to some common solar energy quantities is discussed, and some interpretations are recommended for particular cases. The new system of units is based on metric quantities but is not the same as any previous system of metric units, in other words, both metric and imperial units must be changed to conform to the new system. SI units for energy, power, force, pressure, velocity, flow, and temperature are described, and lists of recommended symbols for material quantities, sun and related angles, miscellaneous quantities, subscripts, and radiation quantities are presented. M I

A78-45830 # Heat transfer in wicks of low-temperature heat pipes (Теплообмін у гнотакх низ'котемпературних теплових труб) V I Tolubinskii, V O Antonenko, Iu M Ostrovs'kii, and E M Shevchuk (Akademiia Nauk Ukrain's'koi RSR, Institut Tekhnichnoi Teplofiziki, Kiev, Ukrainian SSR) *Akademiia Nauk Ukrain's'koi RSR, Dopovidy, Seriya A - Fiziko-Matematichni ta Tekhnichni Nauki*, May 1978, p 466-470. 5 refs. In Ukrainian.

Experiments were conducted to study heat transfer in liquid-saturated metal wicks in low-temperature heat pipes. The cooling liquids used were distilled water at pressures of 0.1-0.4 MPa and butyl alcohol, normal heptane, benzene and acetone at atmospheric pressure. 35 types of porous capillary wick structures were tested. Visualization experiments disclosed no boiling in the wick, but only evaporation of the liquid from the free surface of the meniscus. The evaporation is accompanied by the removal of liquid drops. The mechanism of this process is discussed and, as an illustration, attention is given to the dependence of the heat transfer coefficient on heat flux density for a perforated nickel wick and distilled water at a pressure of 0.4 MPa. B J

A78-45902 # Is Europe's space power technology competitive J J Capart (ESA, Spacecraft Power Supplies Div., Noordwijk, Netherlands) *ESA Bulletin*, no 12, Feb 1978, p 56-61.

The evolution of spacecraft power systems and design requirements are discussed in terms of European development objectives. The economics of European power-system development is examined with attention to the limited scope of research and development possibilities, market considerations, and prospects for reductions in hardware costs. The technology of solar arrays, batteries, and power conditioning is considered, and mass, payload, and photovoltaic requirements are described. M L

A78-45914 Effect of economic development on climate (L'influence du développement économique sur le climat) R Gibrat. *La Météorologie*, Mar 1978, p 5-28. 44 refs. In French.

The paper discusses the problem of the effect on world climate of carbon dioxide gas emissions and thermal waste emissions, and then examines a proposal for using the world's deep ocean waters as a solution to the problem of disposal of CO₂ and thermal emissions. Various past estimates of the contribution by man to fluctuations in

climate, both for the present and extrapolated to the future, are examined. The idea of direct introduction of CO₂ into deep waters, due to Marchetti, is studied. The use of deep waters as a cold water source calls for deeper understanding of ocean variability and the formation of deep waters. P T H

A78-45917 Simplified two-state Markov meteorological model - The Odeillo example (Modèle Markovien simplifié de météorologie à deux états - L'exemple d'Odeillo) R Lestienne. *La Météorologie*, Mar 1978, p 53-64. 5 refs. In French.

A simple meteorological model is developed, where the succession of days is regarded as a Markov chain of two states 'good weather' and 'bad weather'. A day's weather is classified as good or bad according as the ratio of length of time during which the sun shines to the maximum possible it could shine that day is greater or less than 50 percent. The model reproduces satisfactorily most of the features of the phenomena considered, especially the proportion of good weather days and bad weather days and the distribution of lengths of sequences of the same type. The model confirms the importance of correlations between successive days which must be taken into account in predictions of yield and storage requirements of solar power generating plants. P T H

A78-45946 Fluorescent solar energy collectors - Operating conditions with diffuse light A Goetzberger (Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung, Institut für angewandte Festkörperphysik, Freiburg im Breisgau, West Germany) *Applied Physics*, vol 16, Aug 1978, p 399-404. 6 refs. Research supported by the Bundesministerium für Forschung und Technologie.

The fluorescent energy conversion principle using several sheets of transparent material doped with fluorescent molecules to concentrate radiation is extended to include diffuse radiation. Two cases are treated here: diffuse radiation only and a composite spectrum consisting of 40% direct and 60% diffuse radiation simulating the average illumination of a flat exposure in central Europe. In both cases photovoltaic conversion efficiency is significantly higher than with the AM1 spectrum. This is due to the blue shift and narrow shape of the diffuse spectral distributions. With realistic boundary conditions the theoretical conversion efficiency is 1.56 times higher than for the AM1 case. The highest theoretical conversion efficiency is now 38%. (Author)

A78-46023 Elemental particle-size emissions from coal-fired power plants - Use of an inertial cascade impactor J M Ondov, R C Ragani, and A H Biermann (California, University, Livermore, Calif.) *Atmospheric Environment*, vol 12, no 5, 1978, p 1175-1185. 27 refs. Contract No. W-7405-eng-48.

Coal-fly-ash particles collected on coated and uncoated impactor substrates were analyzed by scanning electron microscope techniques in combination with instrumental neutron activation analysis to verify the sizes and elemental composition of collected particles. The results were used to estimate the significance of bounce-off and reentrainment onto back-up filters and to evaluate wall and interstage losses for the University of Washington MK III Source Test Cascade Impactor. Particles were analyzed for a total of 39 elements. Characteristics of particles collected downstream from an electrostatic precipitator and of particles collected on back-up filters are described. Wall and interstage losses of most elements were estimated to be about 40% of mass. A wet scrubber and coated impactor substrates did not greatly reduce bounce-off and reentrainment of small wet particles. M L

A78-46025 An observation of cooling tower plume effects on total solar radiation E Ryznar (Michigan, University, Ann Arbor, Mich.) *Atmospheric Environment*, vol 12, no 5, 1978, p 1223, 1224. 5 refs. Research supported by the Consumers Power Co.

Measurements of total solar radiation were made on 7 March 1977. The sky was cloudless but a cooling tower plume occasionally came between the sun and the pyranometer that was used. These measurements resulted in values that were greater than those expected with a cloudless sky. It is likely that reflections from the

plume, whose average position was slightly north of an imaginary sun-pyranometer line, were responsible (Author)

A78-46028 Mathematical modelling of dispersion and chemical reactions in a plume - Oxidation of NO to NO₂ in the plume of a power plant O T Melo (Ontario Hydro Research Laboratories, Toronto, Canada), M A Lusis (Department of the Environment, Atmospheric Environment Service, Downsview, Ontario, Canada), and R D S Stevens (Ontario Ministry of the Environment, Toronto, Canada) *Atmospheric Environment*, vol 12, no 5, 1978, p 1231-1234 24 refs

A78-46051 Visual impact of plumes from power plants - A theoretical model D A Latimer and G S Samuelsen (California, University, Irvine, Calif) *Atmospheric Environment*, vol 12, no 6-7, 1978, p 1455-1465 25 refs

The impact of emissions on the visibility and esthetic qualities of the existing environment is an important issue in the evaluation of the environmental effects of power plants. The reported investigation has the objective to present and to illustrate the use of a mathematical model for predicting the visual impact of emissions from a power plant based on a knowledge of expected pollutant emission rates and the visual effects of the pollutants. The model is based on the physics of light scattering and absorption but differs from previous models in two key aspects. First, the present model predicts both the impact of the plume on visual range and the color and appearance of the plume. Second, the present work takes into account wavelength-dependent light scattering, scattering and absorption, size distribution and density of fly ash, chemical conversion of nitric oxide to nitrogen dioxide, formation of sulfates and nitrates, and observer-plume geometry G R

A78-46069 A resonating transducer for the utilization of sea wave energy. E Taschdjian *Energy Communications*, vol 4, no 4, 1978, p 393-404 5 refs

A device for the utilization of the energy of sea waves is described, consisting essentially of a narrowing channel, a swimmer, a magnetized lever and a set of transducing wires. The whole arrangement is modelled upon and is analogous to the structure and function of the mammalian ear. It is proposed that the electricity produced, after rectification, be used locally for the electrolysis of sea water (Author)

A78-46119 Advances in and prospects for the development of solar power generation in the USSR S A Azimov (*Geliotekhnika*, no 5, 1977, p 3-8) *Applied Solar Energy*, vol 13, no 5, 1977, p 1-5 Translation

The article presents a broad survey of the development of solar power engineering in the USSR. Attention is given to regional programs utilizing solar energy for various everyday tasks, the construction of solar-heated dwellings, the development of solar distillers, and the construction of solar furnaces. Plans for building solar power stations are reviewed as are projects for the automatic transformation of solar into mechanical energy using the Stirling engine or Rankine cycles. Plans for the generation of energy from solar power using conical and cylindrical concentrators and Fresnel mirrors are proposed. Particular consideration is given to research in solar energy as applicable to agricultural projects SCS

A78-46120 Development and application of the moiré method in solar engineering problems. Iu K Shcherbakov and L P Tairova (Moskovskoe Vyshee Tekhnicheskoe Uchilishche, Moscow, USSR) (*Geliotekhnika*, no 5, 1977, p 9-17) *Applied Solar Energy*, vol 13, no 5, 1977, p 6-12 10 refs Translation

Consideration is given to the moiré method as applied to measuring the angles of rotation of normals and the curvature of reflecting surfaces of solar engineering apparatus. Various procedures for visualizing moiré maps are discussed with reference to circular and hexagonal film facets. The results indicate that the proposed method is effective for defining the characteristics of flexible concentrators having various types of supports, two-dimensional

laminar reflectors of various forms, and for the form control of reflecting surfaces during their manufacture and use SCS

A78-46121 Comparative analysis of models of irradiance field formation in wide aperture-optical systems I V Baum and S O Mamedniyazov (Akademiya Nauk Tadzhikskoi SSR, Fiziko-Tekhnicheskii Institut, Dyushambe, Tadzhik SSR) (*Geliotekhnika*, no 5, 1977, p 26-36) *Applied Solar Energy*, vol 13, no 5, 1977, p 19-26 14 refs Translation

The article briefly discusses the development of wide-aperture optical systems used for concentrating radiated streams, and employed in devices such as optical furnaces with artificial sources, high-temperature solar furnaces, and parabolic reflectors in radio-telescopes. A comparative analysis is presented of various models of the irradiance fields of such wide-aperture optical systems. The analysis is based on mathematical calculations of the primary radiation source characteristics, concentrator parameters, and the thermal regimes of the receiver SCS

A78-46122 Equalization of irradiation field on receiver surface. I V Baum and S O Mamedniyazov (Akademiya Nauk Tadzhikskoi SSR, Fiziko-Tekhnicheskii Institut, Dyushambe, Tadzhik SSR) (*Geliotekhnika*, no 5, 1977, p 37-43) *Applied Solar Energy*, vol 13, no 5, 1977, p 27-32 Translation

For many types of equipment based on radial heating, the homogeneity of the irradiance field of solar concentrators has been emphasized. The article presents a computational procedure for evaluating the homogeneity of irradiance fields on the surface of two-dimensional receivers. Consideration is also given to losses in boundary homogeneity caused by the finite angular dimensions of the source SCS

A78-46123 Evaluation of deformation technique for forming solar concentrator reflecting surfaces. R A Zakhidov, Iu A Dudko, O P Petrosov, G S Zmener, and L A Dubrovskii (Akademiya Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe i Tekhnologicheskoe Biuro Nauchnogo Priborostroeniya, Uzbek SSR) (*Geliotekhnika*, no 5, 1977, p 44, 45) *Applied Solar Energy*, vol 13, no 5, 1977, p 33, 34 Translation

A78-46124 On the role of macrorelief of semiconductor branches during their commutation in thermoelements E A Malygin and M P Kozorezov (Voronezhskii Politehnicheskii Institut, Voronezh, USSR) (*Geliotekhnika*, no 5, 1977, p 46-48) *Applied Solar Energy*, vol 13, no 5, 1977, p 35-37 Translation

A study is made to determine the dependency of the mechanical strength of a semiconductor on the degree of roughness of its branches. Low-temperature thermoelectric materials based on Bi, Se, Te, and Sb are considered. The branches were formed by a technique of compression followed by annealing. Geometrical impurities of the backing are found to significantly influence nucleation during condensation. Two types of impurities are identified: macroscopic and microscopic. Using microphotographs and corresponding profilograms, the influence of macrodefects on the surface of semiconductor branches is studied SCS

A78-46125 Classification of wind and solar power plant output regulation modes R B Salieva (Tashkentskii Elektrotekhnicheskii Institut Sviazi, Tashkent, Uzbek SSR) (*Geliotekhnika*, no 5, 1977, p 49-60) *Applied Solar Energy*, vol 13, no 5, 1977, p 38-47 14 refs Translation

Consideration is given to monitoring the productivity of wind and solar power stations on daily, seasonal, and many-year bases. Methods for calculating the parameters of wind and solar energy collectors are proposed, noting those based on data gathered over many years, and those based on statistics and probability. The conditions under which each of the methods may be used are identified SCS

A78-46126 Polyurethane foam solar energy concentrator resistance to climatic influences B A Bazarov, A G Dement'ev, and B A Kalinin (Akademiia Nauk Tadzhikskoi SSR, Fiziko-Tekhnicheskii Institut, Dyushambe, Tadzhik SSR, All-Union Scientific Research Institute of Synthetic Resins, USSR) (*Geliotekhnika*, no 5, 1977, p 67-71) *Applied Solar Energy*, vol 13, no 5, 1977, p 53-56 8 refs Translation

A78-46127 Intermittent-operation absorption solar refrigerator A T Vakhidov and T M Maksudov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR) (*Geliotekhnika*, no 5, 1977, p 76-78) *Applied Solar Energy*, vol 13, no 5, 1977, p 60-62 8 refs Translation

A study is made of an absorption solar refrigerator based on a liquid. Particular attention is given to a model solar refrigerator having periodic operation and using ammonia as a cooling agent and water as an absorber. It is found that the apparatus' thermal inertia is a function of heat capacity, generator-absorber mass, and the ammonia-water solution. A numerical procedure is derived for determining the necessary amount of this solution, and optimal concentrations are given for various times of the year. S.C.S.

A78-46128 Structure of beam reflected by heliostat V K Baranov (*Geliotekhnika*, no 6, 1977, p 3-10) *Applied Solar Energy*, vol 13, no 6, 1977, p 1-6 Translation

If a heliostat is situated at a considerable distance from the illuminated target, the structure of the reflected beam will be considerably different from that of the original solar beam. It is shown that for a heliostat-target distance of about 107 times the diameter of the heliostat aperture, there will be a central zone in the form of a convergent cone within which the flux density is uniform and varies little from the flux incident on the reflector. Further on there is a stretch, the central zone of which has the form of a divergent cone, where the flux density decreases with the square of the distance from the reflector. P.T.H.

A78-46130 Technological evolution of the quality of facets produced by deformational forming R A Zakhidov, Iu A Dudko, and L A Dubrovskii (Akademiia Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe i Tekhnologicheskoe Biuro Nauchnogo Priborostroeniia, Uzbek SSR) (*Geliotekhnika*, no 6, 1977, p 19-22) *Applied Solar Energy*, vol 13, no 6, 1977, p 13-15 Translation

A mixed numerical-experimental method of evaluating the quality of the facets of solar concentrators is proposed. The method is such that the quality of a facet, by which is meant principally the concentrating power of the facet, can be estimated during the development of a processing method. Hence it is based on results of local monitoring of the concentrating power, with comparisons being made with calculations for an ideal concentrator. P.T.H.

A78-46131 Automatic control of tower-type solar power station optical system /Survey/ A M Khalykov and R R Aparisi (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR) (*Geliotekhnika*, no 6, 1977, p 23-31) *Applied Solar Energy*, vol 13, no 6, 1977, p 16-22 14 refs Translation

Two possible schemes for controlling the mirror reflectors (heliostats) of the optical concentrator of a solar power station using the concept of a solar tower are outlined. The two schemes call for individual control and centralized control, respectively, of the system of heliostats. In the former concept, each heliostat has its own servosystem providing independent angular displacement. The latter concept, suited for large systems, incorporates into an individual control system the possibility of feedback and monitoring control. P.T.H.

A78-46132 Photoelectric radiation densitometer B A Bazarov, Kh Bazarov, and D S Strebkov (Akademiia Nauk Turkmeniskoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR) (*Geliotekhnika*, no 6, 1977, p 32-34) *Applied Solar Energy*, vol 13, no 6, 1977, p 23-25 Translation

A method allowing measurement of radiation flux at any point of a region with high flux density is described. The sensitive element is a high-voltage matrix photocell. Several of these devices are displaced through the focal region of a concentrator at a velocity not exceeding the velocity corresponding to the maximal critical frequency of the p-n junctions of the photocells. If the energy flux exceeds 100,000 V/sq m, the matrix photocells are cooled in a quartz tube filled with circulating water. P.T.H.

A78-46135 Study of the physical and chemical processes in fabricating reflectors from polymer materials O Iu Sobrov, A M Gafurov, S N Vil'kova, and G Ia Umarov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR) (*Geliotekhnika*, no 6, 1977, p 44-49) *Applied Solar Energy*, vol 13, no 6, 1977, p 33-37 Translation

The study concerns the physicochemical processes involved in the formation of a strong bond between the coating material and the reflecting surface of a foam-film solar concentrator. Attention is given to (1) formation of contact, i.e., physical approach of the molecules of the vapor-deposited polymers and the substrate to the proper distance for chemical reaction, (2) activation and chemical interaction of the molecules, leading to a strong bond, (3) film formation, and (4) relaxation processes such as recrystallization, heterodiffusion, new phase formation, etc., which can either enhance or diminish the bond strength. The change in the contact surface during coalescence of like particles is analyzed, and the relation between temperature, viscosity and surface tension of the material is examined. Optimal process parameters are determined. P.T.H.

A78-46136 Influence of heat treatment on solar energy collector optical properties A A Fattakhov, Sh A Faiziev, U Kh Gaziev, and V S Trukhov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR) (*Geliotekhnika*, no 6, 1977, p 50, 51) *Applied Solar Energy*, vol 13, no 6, 1977, p 38, 39 8 refs Translation

A78-46137 Thin-film black-and-white coatings for solar energy collectors V V Li, Sh A Faiziev, U Kh Gaziev, and V S Trukhov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR) (*Geliotekhnika*, no 6, 1977, p 52-55) *Applied Solar Energy*, vol 13, no 6, 1977, p 40-42 8 refs Translation

The paper describes the development of a high-temperature selective coating for solar receivers using SiO₂ and CeO₂ for the dielectric layers and a thin film of molybdenum as the metallic layer. Three different materials were used for the substrates: stainless steel, glass covered by an aluminum film, and molybdenum foil. The thicknesses of the metallic and dielectric layers were optimized experimentally. From transmission and reflection curves it was determined that the optimal thickness of the molybdenum film is 250-300 Å. By using two-layer antireflection coatings it was possible to raise the absorption coefficient to 0.85-0.9. When molybdenum foil or Al-coated glass are used as substrate, the integral radiation coefficient is lowered to 0.06-0.1. P.T.H.

A78-46138 Calculation of cylindrical pebble-bed hothouse heat accumulator gasdynamic resistance B Khairtdinov, T A Sadykov, and A B Vardnashvili (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Karshinskii Gosudarstvennyi Pedagogicheskii Institut, Karshi, Uzbek SSR) (*Geliotekhnika*, no 6, 1977, p 73-75) *Applied Solar Energy*, vol 13, no 6, 1977, p 59-61 8 refs Translation

The paper describes an empirical method of determining the hydraulic resistance of an underground heat accumulator consisting

of a cylinder filled with pebbles and wrapped in a transparent polyethylene film. The method is based on measuring the flow rate of water through the accumulator at various pressures. The dependence of hydraulic pressure on Reynolds number is determined. The results can be transferred to the case of air in order to determine the proper power of the fan. P T H

A78-46184 Axial feedback stabilization of flute mode in a multiple mirror. S L Wong and M A Lieberman (California, University, Berkeley, Calif.) *Plasma Physics*, vol 20, May 1978, p 403-408. 14 refs. NSF Grant No. ENG-75-02709, Contract No. E(04-3)-34-PA-215.

Experimental results are reported for axial feedback stabilization by line-tying the $p = 1$ flute mode in a multiple-mirror plasma where the growth rate greatly exceeds the rotation frequency. A seven-cell multiple-mirror configuration was used and in steady state the plasma was produced by constant ionization of lithium vapor on a tungsten plate at nominally 2500 K. Plasma density ranged from 10 to the 10th/cu cm near the hot plate to 10 to the 9th/cu cm near the endwall. Langmuir probes biased to -12 volts were used to sense the plasma perturbation at the edge and in the center of the plasma. It was found that the $p = 1$ flute mode is developed in the absence of feedback. The gain amplitude versus the phase angle is plotted for a 600-microsec confinement time during which the plasma decays to 90% of the original level. S C S

A78-46185 Beta-dependence of the particle and energy confinement times in the low collisionality regime in toroidal systems. R M O Galvão (Campinas, Universidade Estadual, Campinas, São Paulo, Brazil) *Plasma Physics*, vol 20, May 1978, p 409-414. 6 refs. Research supported by the Financiadora de Estudos e Projetos, Conselho Nacional de Pesquisas Grant No. 8271/75.

A78-46194 The theoretical energy conversion efficiency of a high temperature fuel cell based on a mixed conductor. D S Tannhauser (Technion - Israel Institute of Technology, Haifa, Israel) *Electrochemical Society, Journal*, vol 125, Aug 1978, p 1277-1282. 7 refs. Research supported by the National Council of Research and Development of Israel and Kernforschungsanlage Jülich.

We have calculated the voltage vs current characteristic and the energy conversion efficiency of a fuel cell based on a mixed ionic-electronic conductor. The transport equations for the electrolyte are solved exactly and the material parameters which determine the shape of the characteristic are determined. The equations are then applied to the special case of doped ceria, which becomes a mixed conductor only at low oxygen pressures. We then show that for the purpose of efficiency calculations, the finite but small ratio of ionic to electronic mobility valid for ceria can be safely taken as zero, and we compare the resulting simple equations with the equivalent circuit approach to a fuel cell. The characteristic is found to be curved instead of being a straight line and for typical operating conditions the best energy conversion efficiency is, for the transport theory approach, 50% higher than for the equivalent circuit one. We conclude from the calculated new values of conversion efficiency that the equivalent circuit underestimates the conversion efficiency of a mixed conductor seriously and that doped ceria as a solid electrolyte is a more serious contender to doped zirconia than believed up to now. (Author)

A78-46196 The possibility of black zinc oxide as spectrally selective coating for low temperature solar collectors. M van der Leij (Delft, Technische Hogeschool, Delft, Netherlands) *Electrochemical Society, Journal*, vol 125, Aug 1978, p 1361-1364. 9 refs.

The best spectrally selective surface, taking into account corrosion resistance and thermal and UV stability, appears to be zinc oxide on polished leaf-zinc prepared by anodic treatment of the substrates in a solution containing 30 g/l NaOH, 20 g/l NaNO₃, and 5 g/l NaClO₂ at 40 C bath temperature with 20 (ac) A/sq dm for 1 min or slightly longer treatment time. The present paper describes the preparation of this spectrally selective coating for low temperature solar collectors, and presents results of optical measurements (in the

0.35-2.5 micron range), and discusses the effects of temperature and UV aging. Normal hemispherical spectral reflectivity curves for the coating are presented. R J

A78-46279 # Study of the thermophysical characteristics of cryogenic heat pipes with a metallic fibrous wick (Issledovanie teplofizicheskikh kharakteristik kriogenykh teplovyykh trub s metallovoloknistym fitilem) M G Semena and A I Levterov (Kievskii Politehnicheskii Institut, Kiev, Ukrainian SSR) *Inzhenerno-Fizicheskii Zhurnal*, vol 35, July 1978, p 48-53. 11 refs. In Russian.

The experiments described were carried out to study the thermophysical characteristics of liquid-hydrogen heat pipes with fibrous stainless steel and copper wicks. The temperature fields and critical heat fluxes are determined as a function of heat-transfer-agent excess and heat-pipe angle of inclination. The influence of the thermophysical properties of the working fluid and transport properties of the wicks on heat pipe performance is investigated. It is shown that heat pipes of this type exhibit excellent heat transfer characteristics. V P

A78-46369 Assessing coal conversion processes. J T Talty (National Institute for Occupational Safety and Health, Cincinnati, Ohio) *Environmental Science and Technology*, vol 12, Aug 1978, p 890-894. 7 refs.

Consideration is given to the health hazards associated with coal conversion processes. The available coal-gasification unit operations, coal-liquefaction processes, and gas-liquor treatment techniques are identified. Procedures are suggested for the collection and analysis of samples and for air monitoring at various workplaces. Specific areas for research and development are discussed, including studies of trace elements in coal-conversion plants, volatiles occurring in cooling water through leakage, the composition of purge streams, and the leachability of inorganic materials from coal ash. S C S

A78-46371 Fluidized-bed combustion of coal with lime additives - Catalytic sulfation of lime with iron compounds and coal ash. R T Yang, M S Shen, and M Steinberg (Brookhaven National Laboratory, Upton, N Y) *Environmental Science and Technology*, vol 12, Aug 1978, p 915-918. 19 refs. Contract No. EY-76-C-02-0016.

A78-46443 Amorphous silicon as a selective absorber of solar energy - A spectral emissivity study. J O White (California Institute of Technology, Pasadena, Calif.), T R Kirst, and J Tauc (Brown University, Providence, R I) *Applied Optics*, vol 17, Aug 1, 1978, p 2427-2430. 8 refs. NSF Grant No. DMR-76-17443.

A method for the measurement of the thermal emissivity of films on substrates and for the subsequent determination of the optical constants is described. It is applied to sputtered amorphous silicon films on sapphire substrates. The results, obtained in the 3-6.3 micron spectral range and at 400-800 C, confirm the existence of residual ir absorption in this region with an absorption coefficient on the order of 100. (Author)

A78-46444 * Solar concentrating properties of truncated hexagonal, pyramidal and circular cones. D G Burkhard, G L Strobel (Georgia, University, Athens, Ga), and D L Shealy (Alabama, University, Birmingham, Ala) *Applied Optics*, vol 17, Aug 1, 1978, p 2431-2449. Research supported by the University of Georgia, Contract No. NAS8-32149.

The solar concentrating properties of specularly reflecting truncated pyramidal, hexagonal, and circular cones are evaluated. Pyramidal and hexagonal configurations are discussed with reference to the concentration factor as a function of half apex angle and the length of the side over the width, and to the irradiance distribution. Expressions are derived for the concentration factor and the irradiance at the base of a circular cone when the sunlight is incident normal to the aperture and for oblique incidence. S C S

A78-46446 Effect of finite conductivity on vertical stability of a tokamak plasma column with a noncircular cross section without conducting shell. K Sakurai, T Okuda (Nagoya University, Nagoya, Japan), and Y Tanaka (Japan Atomic Energy Research Institute, Tokyo, Japan) *Electrical Engineering in Japan*, vol 97, July-Aug 1977, p 15-19 9 refs Translation

A78-46474 Research challenge - Clean energy from coal. B. R. Cooper (West Virginia University, Morgantown, W Va) *Physics Today*, vol 31, Aug 1978, p 32-39 22 refs

Research approaches to reducing pollution from coal combustion are discussed. Techniques for analyzing coal are considered, procedures for removing impurities from coal are examined, and the use of catalysts is surveyed. Coal-fired MHD power generation is described with attention to problems caused by erosion and corrosion. The effect of the use of coal on the environment is examined. Problems associated with an increase in atmospheric CO₂ levels are considered, and the need for innovative mining techniques is explained. M L

A78-46488 The employment of the X-ray fluorescence radioisotope technique for the determination of sulfur in fuel oils (L'impiego della tecnica XRF radioisotopica per la determinazione dello zolfo negli oli combustibili). M Salmi (Calabria, Università, Cosenza, Italy), L Storelli (Roma, Università, Roma, Italy), and F Vicinanza (Metronik, Rome, Italy) *Inquinamento*, vol 20, May 1978, p 41-43 6 refs In Italian

The determination of the sulfur content in fuel oils is important in connection with an evaluation of the amount of air pollution due to sulfur dioxide which might be caused as a consequence of the use of the fuel. Conventional standard techniques of analysis are too complex for routine and line controls of the fuel, and a simple analysis procedure is needed. A description is presented of a radioisotope X-ray fluorescence technique which satisfies the requirements for such a rapid and simple analysis method. The conventional analytical standard methods for the determination of sulfur concentration are also discussed. G R

A78-46490 Fiat has presented at Basel its proposal in the field of recycling (La Fiat ha presentato a Basilea la sua proposta nel campo del riciclo). *Inquinamento*, vol 20, May 1978, p 83-87 In Italian

The paper describes the Totem (Total Energy Module) system which is based on the use of a Fiat 127 motor to produce heat for water heating and electric energy from the combustion of methane, alcohol, commercial gas, or other fuel. The gas generated by the fermentation of domestic, agricultural, or industrial wastes would be a suitable fuel. A unit would be capable of simultaneously producing 15 kW and 33,000 kcal/hr, and if the equivalent of 50,000 kcal/hr of methane is consumed, only 10 percent of the heat would be lost. The noise level can be kept to less than 70 dB. Networks involving Totem and fuel sources from recycling are considered. M L

A78-46525 Thermal storage. T S Dean (Kansas, University, Lawrence, Kan.) Philadelphia, Pa., Franklin Institute Press, 1978 58 p 29 refs \$6 50

The problems of thermal energy storage are examined in terms of the design characteristics of systems to be used with solar heating units. Among the systems considered are active and passive heating, water, rock, and hybrid systems, and specially designed houses. The physics of heat storage are discussed with reference to heat conduction and loss in storage, and in terms of storage materials and the size and shape of storage containers. D M W

A78-46579 # Heat balance of earth (Teplovoy balans zemli). M I Budyko, T G Beriland, N A Efimova, L I Zubenok, and L A Strokina. Leningrad, Gidrometeoizdat, 1978 41 p 51 refs In Russian

Results of improved calculations of the heat-balance components of earth's surface are reported for yearly average conditions. The technique used to determine the heat-balance components from

land- and sea-based actinometric observations as well as from satellite data on the radiation balance of the earth-atmosphere system is described in detail, with special attention given to short-wavelength solar radiation on the continents, effective radiation from the land surface, the radiation balance of the ocean surface, heat expended by evaporation from the land surface, and heat expended by both evaporation from the ocean surface and turbulent heat transfer between the ocean surface and the atmosphere. World maps of heat-balance components are presented which show yearly average values of total radiation, radiation balance, heat expended by evaporation, the turbulent heat flow between earth's surface and atmosphere, and heat transfer between the ocean surface and underlying waters. The global surface heat balance is estimated along with global values of the various components and the heat balance components for different latitude zones. F G M

A78-46601 Distributed solar power systems - An option. A B Meinel and M P Meinel (Arizona, University, Tucson, Ariz.) (American Association for the Advancement of Science, Annual Meeting, Denver, Colo., Feb. 21-26, 1977) *Energy*, vol 3, Summer 1978, p 23-25

The paper is concerned with the economics of a distributed system of individual solar collector modules interconnected to a single power producing unit by the means of a heat transfer medium. A distributive system can use fixed mirror collectors which have a better survivability/cost relationship than heliostat or tracking collectors, and some examples of modular concentrating collectors are examined. The use of three large modules and the use of 100 small modules are compared. A cost effectiveness study of solar power collectors suggests that significant cost reductions are necessary to equal the cost of power from conventional power plants. Ways of improving the cost effectiveness of solar systems are considered. M L

A78-46602 Production of medium pressure process steam from low temperature geothermal fluid. C D Hornburg (DSS Engineers, Inc., Ft. Lauderdale, Fla.) *Energy*, vol 3, Summer 1978, p 29, 30

Procedures for utilizing large amounts of moderate-temperature geothermal energy are examined, and the cost and profitability of geothermal energy supply systems are discussed with reference to the supplying of energy to a 1000-ton-per-day bleached kraft pulp and paper mill. Steam compression is considered, and it is suggested that a multieffect compression with desuperheating between effects would give reasonable efficiency coupled with simplicity. A simplified geothermal energy self-beneficiation system is described, this system, which uses only geothermal fluid after flashing to heat, evaporates isobutane which passes through a turbine driving the steam compressors. It is thought that processes can be grouped together at specific geothermal sites for synergic production of products in an optimum economic manner. M L

A78-46825 Solar energy satellites and satellites for energy transmission (Sonnenenergie-Satelliten und Energie-Übertragungs-Satelliten). H Hartbaum (Telefunken AG, Backnang, West Germany) (Verband Deutscher Post-Ingenieure, Post- und Fernmelde-technische Tagung, Hanover, West Germany, Apr 22, 1977) *Astronautik*, vol 15, no 3, 1978, p 78-83 In German

The possibility of using large geosynchronous satellite platforms for the collection of solar energy to be transmitted in the form of microwaves to earth antennas is examined in terms of available and predictable advances in technology, and in terms of cost. Three basic design concepts are presented: thermoelectric, whereby a large parabolic reflector concentrates solar energy onto an absorber for an actual power capability in the 10 GW range, photoelectric, which uses photovoltaic cells for the direct conversion of solar energy (a simpler but less powerful technique than thermoelectric), and a smaller (100 kW) modular concept employing characteristics of both thermo- and photoelectric methods, whereby the main advantage is ease of assembly. Also briefly considered is the possibility of a simple microwave reflector in GEO, which could transmit energy generated on earth to another earth receiving station. D M W

A78-46872 Energy - A review and survey B F Williams (RCA Laboratories, Princeton, NJ) *RCA Engineer*, vol 24, June-July 1978, p 10-17 7 refs

It is noted that growth in U.S. energy demand has up till now been met by increased consumption of easily accessible supplies of oil and natural gas (this availability also includes OPEC production, which, though expensive, has allowed the West to rely on its traditional energy sources). Even OPEC oil, however, will begin to fall short of demand before the end of the century, and energy supplies will have to be found elsewhere. For the medium-term (until the first decades of the 21st century), this means conversion of oil and natural gas facilities (mostly in industry) to coal, more nuclear power plants are also required, and hydroelectric facilities can be expanded. Eventually, inexhaustible sources of energy, i.e., solar and nuclear fusion, will become economical. Attention is given to both national and RCA company strategy for dealing with the energy crisis, i.e., conservation, conversion to abundant indigenous North American sources, and research into new energy technologies.

D M W

A78-46873 Comparative numerical studies of ideal magnetohydrodynamic instabilities M S Chance, J M Greene, R C Grimm, J Manickam (Princeton University, Princeton, NJ), W Kerner (Max-Planck-Institut für Plasmaphysik GmbH, Garching, West Germany), D Berger, L C Bernard, R Gruber, F Troyon (Lausanne, Ecole Polytechnique Federale, Lausanne, Switzerland), and J L Johnson *Journal of Computational Physics*, vol 28, July 1978, p 1-13 15 refs. Research supported by the Swiss National Science Foundation, Contract No. EY-76-C-02-3073

Stability properties associated with a specific analytic equilibrium have been calculated to compare the accuracy of three large computational programs that have been developed at Garching, Princeton, and Lausanne. All three use a Galerkin formulation of the variational principle for determining spectra. Good agreement is found, verifying the efficacy of all three codes. (Author)

A78-47187 # The concept of availability for gas turbine application evaluation T C Heard and R P Lang (General Electric Co., Schenectady, NY) (*American Society of Mechanical Engineers, Gas Turbine Conference, London, England, Apr 9-13, 1978, Paper 78-GT-140*) *ASME, Transactions, Journal of Engineering for Power*, vol 100, July 1978, p 452-456

It is attempted to demonstrate that the productivity of different gas turbine applications and arrangements can be relatively easily estimated. The availability of a gas turbine or installation is the portion of time the turbine or installation is capable of normal operation when it is needed. A general probability formula which indicates the fraction of the time which a specific number of units can be expected to be shut down and unavailable is presented for an installation with more than one gas turbine unit. Attention is given to single station expected power productivity, single station expected flow productivity, a single station with one spare unit, and pipeline productivity. G R

A78-47190 # Hydrogen gas generation in water heat pipes G F Pittinato (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.) *ASME, Transactions, Journal of Engineering Materials and Technology*, vol 100, July 1978, p 313-318 13 refs NSF Grant No. GI-41310

Water heat pipes were fabricated from 316, 347, and 430 stainless steel, Monel 400, CDA 715, Inconel 600, and Incoloy 800. All of these materials generated varying amounts of hydrogen gas during the first few days of operation. However, as the heat pipes continued to operate, the amount of gas in each heat pipe, excluding 430 stainless steel, decreased by permeating through the heat pipe walls. Inconel 600 appeared to be the most acceptable material for water heat pipes by returning to isothermal operation over a short time period. An equation based on a diffusion dependent mechanism was developed that predicts heat pipe performance recovery rates.

(Author)

A78-47205 Oil-shale kerogen - Low temperature degradation in molten salts R C Bugle, K Wilson, G Olsen, L G Wade, Jr., and R A Osteryoung (Colorado State University, Fort Collins, Colo.) *Nature*, vol 274, Aug 10, 1978, p 578-580 12 refs. Research supported by the U.S. Department of Energy.

The degradation of Green River oil shale, principally at 320°C, with use of a sodium chloride-saturated tetrachloro-aluminate melt is studied. Yield data are presented, and it is found that, while aromatic moieties are relatively inert to the solvent system, aliphatic materials containing carbon in other than sp³ hybridization are especially reactive. It is suggested that the mechanism of degradation involves intramolecular disproportion catalyzed by the tetrachloroaluminate melt's ability to stabilize the resulting short-lived intermediates until the participating macromolecules have been sufficiently reduced in size to become soluble in conventional solvents. M L

A78-47269 # Let's put fuel efficiency into perspective J P Dow (Grumman American Aviation Corp., Savannah, Ga.) *Aircraft Engineering*, vol 50, July 1978, p 24-27

The paper discusses several measures of fuel efficiency and examines the advantages of each as it applies to business aircraft. The measures of efficiency discussed are passenger miles, fuel consumption per mile or specific range, range factor (a measure of design efficiency), and specific fuel consumption (a measure of engine efficiency). Figures are presented illustrating changes of specific fuel consumption for four different conditions of net thrust definition. Specific range comparisons are then presented for a mission of 500 nautical miles along with a range factor analysis for missions of the same distance. B J.

A78-47295 Radial profile of dc toroidal current driven by RF travelling field M Fukuda (Nagoya University, Nagoya, Japan) *Physical Society of Japan, Journal*, vol 45, July 1978, p 283-288 20 refs

The radial profile of dc toroidal current driven by an RF travelling field is studied experimentally in a magnetized plasma, in connection with the radial profile of RF field. As the toroidal magnetic field increases, the RF field penetrates the plasma and becomes bell-shaped profile, while the dc current has a hollow structure. The hollow type structure of induced current is interpreted on the basis of force balance between the electromotive force due to RF travelling field and the frictional force due to collisions, where the former is proportional to the absorbed RF power.

(Author)

A78-47423 The second generation of high-bypass turbofans - A market clouded by uncertainty J F Brindley *Interavia*, vol 33, Aug 1978, p 711-714

Second-generation high bypass turbofan concepts for commercial aviation are reviewed in terms of performance and fuel economy. The General Electric/SNECMA CFM56 is considered the most advanced, offering fuel savings on the order of 30% per passenger over older engines. The CFM56 will be rated at 10,885 kp and could enter service by 1981. Other engines are also reviewed, including the RB 211-535, the JT10D, rated at 14,515 kp, to be used in a new Boeing trijet, and the CF6-32, which maintains the core of the Dash-602 while incorporating a new LP turbine and turbine mid-frame. D M W.

A78-47449 A possible explanation for the photovoltaic effect in indium tin oxide on InP solar cells. R Singh and J Shewchun (McMaster University, Hamilton, Ontario, Canada) *Journal of Applied Physics*, vol 49, Aug 1978, p 4588-4591 29 refs. Research supported by the National Research Council of Canada, Contract No. E(04-3)-1203

Recently, Sree Harsha and co-workers reported a 14.4% efficient n-indium tin oxide/p-InP solar cell. In principle, it is difficult to visualize a high-efficiency photovoltaic device with this particular structure because of large interfacial defects due to crystal structure and lattice mismatch. However, an explanation for the operation of

this solar cell based on the presence of a thin interfacial insulating layer between the indium tin oxide and the InP is proposed. The operation is similar to tunnel MIS solar cells where the metal is replaced by a degenerate wide-band-gap oxide (indium tin oxide) semiconductor. The calculations show that such semiconductor-insulator-semiconductor solar cells can yield efficiencies as high as 26% (AM2) with InP as the base semiconductor (Author)

A78-47474 **Advanced processing techniques for the manufacture of nickel-base alloy discs from powder** G J Lewis, D M Parkin, and F A Thompson (Henry Wiggin and Co., Ltd., Hereford, England). In: *Forging and properties of aerospace materials*, Proceedings of the International Conference, Leeds, England, January 5-7, 1977. London, Metals Society, 1978, p 399-416. 15 refs

Powder metallurgical techniques used to obtain disk alloy properties suitable for improving aero gas turbine efficiencies are discussed. Three approaches are examined - the processing of disk alloys to obtain property improvements over existing materials, the utilization of powder metallurgy to shorten disk production routes and reduce costs, and future trends in powder metallurgy for disks. The importance of the ability to produce segregation-free billet is considered, and the capabilities of hot isostatic pressing and powder canning techniques are described. (Author)

A78-47485 **Controlled fusion - Progress to date** M P Bachynski (MPB Technologies, Inc., Ste Anne de Bellevue, Quebec, Canada). *Engineering Journal*, vol 61, July 1978, p 15-19. 9 refs

The development of laser fusion for eventual commercial energy production is reviewed in terms of the physical principles of the deuterium reaction, and in terms of a comparison between the most promising concepts for fusion reactors, i.e., tokamaks and laser fusion. Attention is given to the Canadian research effort, and it is noted that in spite of high quality research being conducted on a small scale, the large scale effort necessary to help meet Canada's future energy needs is lacking. A partial solution may be found in increased Canadian cooperation in international fusion research. (Author)

A78-47596 * # **Substitution of ceramics for high temperature alloys** H B Probst (NASA, Lewis Research Center, Cleveland, Ohio). *American Chemical Society, Federation of Materials Societies and American Society for Metals, State-of-the-Art Symposium on Scarce and Critical Materials, 14th, Washington, D.C., June 5-7, 1978, Paper*. 17 p. 20 refs

Ceramics such as silicon nitride and silicon carbide are currently receiving a great deal of attention as potential materials for advanced gas turbine engines. The primary advantage offered by ceramics is their high temperature capability which can result in turbine engines of improved efficiency. Other advantages when compared to the nickel and cobalt alloys in current use are raw material availability, lower weight, erosion/corrosion resistance, and potentially lower cost. The use of ceramics in three different sizes of gas turbine engines is considered, these are the large utility turbines, advanced aircraft turbines, and small automotive turbines. The effects of material substitutions are reviewed in terms of engine performance, operating economy, and secondary effects. (Author)

A78-47748 **Progress in geothermal energy** J D Garnish (Department of Energy, London, England). *Endeavour*, vol 2, no 2, 1978, p 66-71. 15 refs

Techniques for utilizing geothermal energy are discussed with attention to French installations and the cracking of dry rock. The four geothermal heating installations already functioning in the Paris region draw water (between 57 and 75 C) from 1500-2000 m and serve 13,000 dwellings. The additional use of hot water as a heat pump permits heat utilization until the water temperature is as low as 7 deg, this water is then reinjected into the Dogger sandstone stratum, the source of the hot water. The rock cracking procedure, tested at Los Alamos, involves the pumping of water under pressure into a deep borehole in a uniform impermeable rock; in principle, a

single vertical disk-shaped crack should be formed, and the growth of the crack should be controllable. If a second borehole is drilled to intersect the crack of the first borehole, water circulated in the loop can extract heat from the hot (granite) rock formation. (Author)

A78-47749 **Gasifying coal underground** P N Thompson (National Coal Board, London, England). *Endeavour*, vol 2, no 2, 1978, p 93-97. 7 refs

The technology of underground coal gasification (UCG) is discussed. Topics examined include combustion characteristics, the construction of a linkage channel between boreholes, the use and the upgrading of the gas, methods of underground gasification, and the economics of UCG. Upgrading to a clean fuel gas, to SNG, or to hydrogen as well as production of carbon monoxide are considered, and the linked vertical well system being tested at Hanna, Wyoming is described. It is noted that UCG is not suitable for gasifying thin poor-quality seams, that UCG has considerable environmental effects since a borehole is required every 30 m that is, 20-50 hectares are required for a 100 MW generating station, and that the gas produced is dirty and of low calorific value (4-5 MJ/cu m). (Author)

A78-48056 **A Be p-silicon MIS solar cell** Y Maeda (Hoxan Corp., Sapporo, Japan). *Applied Physics Letters*, vol 33, Aug 15, 1978, p 301, 302. 9 refs

An MIS solar cell, consisting of beryllium on p type silicon with an interfacial oxide layer, has been found to have good conversion efficiency and good reproducibility. Sunlight conversion efficiency appeared to be more than 9% without the use of an antireflection coating. (Author)

A78-48097 # **Modeling and evaluation of combustion process of a three-valve stratified charge engine** T Asanuma (Tokyo, University, Tokyo, Japan), M K Gajendra Babu (Tokyo, University, Tokyo, Japan, Indian Institute of Technology, Bombay, India), and S Yagi (Tokyo, University, Tokyo, Honda Research and Development Co., Ltd., Japan). *Tokyo, University, Institute of Space and Aeronautical Science, Report* no 556, vol 43, Apr 1978, p 15-28. 12 refs. Research supported by the Japan Society for the Promotion of Science.

This paper describes the development of a mathematical model for the compression, combustion and expansion process of a stratified charge engine, consisting of an auxiliary combustion chamber with an inlet valve and a main combustion chamber with both the inlet and exhaust valves. After calculating the mixture formation at the end of compression process, a simple combustion model was developed to compute the gas temperature, gas pressure and the rate of formation of NO and CO at each crank angle, using the basic energy equation and reaction kinetics for both the auxiliary and main chambers. The above calculations were also extended for the expansion process. The evaluation of the model was carried out by comparing the computed and experimental data. A satisfactory correlation was observed between them. (Author)

A78-48360 # **In vitro models for photosynthesis /The Bakerian Lecture, 1977/** G Porter (Royal Institution of Great Britain, Davy Faraday Research Laboratory, London, England). *Royal Society (London) Proceedings, Series A - Mathematical and Physical Sciences*, vol 362, no 1710, Aug 22, 1978, p 281-303. 28 refs. Research supported by the Science Research Council, English Electric Co., and General Electric Co.

In vitro systems which perform photosystem II reactions are described. The reactions which are modeled, which are probably the principal stages of the process, involve (1) light harvesting and trapping, (2) electron transfer from chlorophyll to a quinone, and (3) oxidation of water via an intermediate containing manganese. For the first reaction, kinetic studies in vitro are reported for porphyrin-dium cruentum as well as chlorophyll A in chlorella and chloroplasts. In vitro models of the light harvesting unit and mechanisms of concentration quenching are examined. Models for the third reaction are discussed with reference to the photochemical reactions of

The use of beta-alumina as a solid ionic conductor in a variety of power sources is now well established. The properties of beta-alumina with regard to these devices are discussed with particular reference to the sodium-sulphur battery. The relationships between phase composition and microstructure with ionic conductivity and mechanical strength are considered and the constraints these properties place on cell design are outlined. Recent experimental data on the mechanical and electrical behaviour of beta-alumina are reported and critical problems for the successful application of beta-alumina are identified. (Author)

A78-49328 # A program code and tables of analytical solutions of the Helmholtz equation for toroidal coordinates. M. Seki, I. Kaji, and T. Honma. *Hokkaido University, Faculty of Engineering, Bulletin*, Aug 1978, p. 23-40. 5 refs. In Japanese, with abstract in English.

The Helmholtz equation is solved in toroidal coordinates. The solutions are useful for analyses of a toroidal plasma and of other problems to be solved in toroidal coordinates. A FORTRAN program for numerical calculation uses series representation of Legendre functions. The solutions of the Helmholtz equation for toroidal coordinates were computed by the FORTRAN program and tabulated. (Author)

A78-49335 Nuclear process heat for coal gasification and hydrogen production. K. F. Knoche (Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany). *Progress in Energy and Combustion Science*, vol. 4, no. 2, 1978, p. 63-72. 14 refs.

The basic concepts of nuclear coal gasification with steam and with hydrogen are described, cost factors in the processes are reviewed, and the status of hydrogen production with nuclear process heat is discussed. Nuclear latent heat transport is discussed, and is shown to be a possible means of reducing gas consumption is introduced into a general gas distribution system. For countries where coal mining and coal production costs are quite high, nuclear coal gasification can be competitive with conventional gasification methods. Cost estimates for hydrogen production by thermochemical and hybrid cycles indicate that so far they are not competitive with energy conversion processes using fossil fuels, but they do have potential to be competitive with direct water electrolysis. P. T. H.

A78-49337 Fifty years of combustion research at General Motors. W. G. Agnew (GM Research Laboratories, Warren, Mich.). *Progress in Energy and Combustion Science*, vol. 4, no. 2, 1978, p. 115-155. 127 refs.

This paper surveys the work and research carried out at one automotive research laboratory since 1927 on the single problem of the process of combustion during a cycle in an internal combustion engine. Broken down into the engine types on which the research was focused, the studies embraced the following aspects: (1) conventional spark-ignition engines: preflame reactions, pressure development, halo-carbon effects, hydrocarbon emissions, NO_x formation model, fuel atomization effects, turbulent flame propagation model; (2) diesel engines: additive effects on ignition lag, scavange ratio measurements, hyprex free piston engine movies, diesel odor, emissions reduction, particulate formation; (3) unconventional intermittent combustion engines: 2 stroke U-engine, direct cylinder air injection, stratified charge rotary engine, fuel spray/air flow interaction; (4) continuous combustion engines: T 56 turbojet combustor probing, Stirling GPU combustor, swirl combustor, Rankine engine combustor, catalytic combustion, methanol combustion, and fuel bound nitrogen studies. Research on hydrogen engines is also reported, and examples of some of the instrumentation developed for many of the studies are described. P. T. H.

A78-49421 Observations on boron release from coal-fired power plants. E. S. Gladney, L. E. Wangen, D. B. Curtis, and E. T. Journey (California, University, Los Alamos, N. Mex.). *Environmental Science and Technology*, vol. 12, Sept 1978, p. 1084, 1085. 24 refs. Research sponsored by the U.S. Department of Energy, NSF Grant No. GI-36338X.

The boron content of coal and power plant process ashes is investigated. Calculation of mass balances suggests that a large fraction of the boron is being released to the atmosphere. (Author)

A78-49603 Some results of researching the application of magnetohydrodynamics in power engineering. E. M. Shelkov, S. I. Pishchikov, M. S. Pinkhasik, and Iu. A. Zakharko (*Magnitnaia Gidrodinamika*, Oct.-Dec. 1977, p. 87-97). *Magnetohydrodynamics*, vol. 13, no. 4, Apr 1978, p. 454-462. 14 refs. Translation.

The results of studies conducted with the aid of various MHD devices, including the U-02 and U-25, are presented. Particular attention is given to the preparation, supply, and heating of oxidants, the intake and outlet of admixtures, combustion chamber parameters, MHD generators, magnetic and inversion systems, and measurement and recording techniques. S. C. S.

A78-49604 Integral characteristics of induction-type MHD machines with large electromagnetic-interaction parameters. R. A. Valdmann, R. R. Krishberg, I. A. Lielpeter, Ch. K. Mikriukov, and L. I. Ulmanis (*Magnitnaia Gidrodinamika*, Oct.-Dec. 1977, p. 107-109). *Magnetohydrodynamics*, vol. 13, no. 4, Apr 1978, p. 471-474. Translation.

A78-49637 Degradation of solar cell efficiency by sheet resistance. K. Lehevec and A. Fedotowsky (Southern California, University, Los Angeles, Calif.). *Solar Energy*, vol. 21, no. 2, 1978, p. 81-86. Contract No. E(49-18)-2457.

The efficiency degradation of solar cells due to sheet resistance-generated losses is computed as a function of light intensity and electrode spacing. The degradation derived by Heizer and Chu is shown to be 33 per cent too large at small electrode spacing. We give an approximate analytic relation for the efficiency degradation and derive from it the electrode spacing which minimizes the combined losses due to sheet resistance and electrode shading. An electrode configuration which prevents extreme power loss by local short circuits in the photojunction is described. (Author)

A78-49638 The photochemical heat pipe. B. Carlsson and G. Wettermark (Kungl. Tekniska Högskolan, Stockholm, Sweden). *Solar Energy*, vol. 21, no. 2, 1978, p. 87-92. 10 refs.

The performance of a solar collector system for high temperature heat delivery based on a photochromic reaction is discussed. The system consists of a non-focusing collector and a reactor integrated into a flow system. In the collector, kept close to ambient temperature, the chemical potential of the photochromic system is increased through an endothermic photochemical reaction and is used to drive the reverse thermal reaction taking place in the reactor at a high temperature. No separation of the photoproducts is involved. Accordingly, the highest temperature at which heat can be delivered from the reactor is determined by the maximum attainable photostationary state in the collector and not, as in a conventional flat-plate collector, by heat-loss from the collector to the surroundings. Accordingly, the highest temperature at which heat can be delivered from the reactor is determined by the maximum attainable photostationary state in the collector and not, as in a conventional flat-plate collector, by heat-loss from the collector to the surroundings. The functioning of the device is exemplified by calculations for a model system utilizing the photodissociation of gaseous nitrosyl-chloride. The results show that it should be possible to build a system which, on a clear day, delivers about 100 W heat at temperature above 200°C for each square meter of collector area. A tenfold reduction in the radiation flux density of the incident light will only slightly reduce output efficiency. (Author)

A78-49639 'Wet-type' solar cells with semiconductor electrodes. H. Tsubomura, M. Matsumura, K. Nakatani, Y. Yamamoto, and K. Maeda (Osaka University, Toyonaka, Japan). *Solar Energy*, vol. 21, no. 2, 1978, p. 93-98. 16 refs.

The photovoltages and photocurrents arising from 'wet' solar cells of the type, (semiconductor electrode/aqueous solution of electrolyte/platinum electrode), have been measured and discussed. Earlier work by the present authors and others on such 'wet' solar

cells using a semiconductor electrode is briefly and critically reviewed. The effect of dyes, either dissolved in the solution or coated on the electrode surface, was studied in detail including the effect of reducing agents, which turned out to act as electron suppliers. The photovoltaic effects in nonaqueous solutions were also studied. The photocurrent efficiencies of the dye-sensitized cells were improved by increasing the quantities of dyes adsorbed on the surface and reached 19 per cent for monochromatic illumination at the wavelengths of the absorption peaks of the dyes and under sufficient anodic biases (Author)

A78-49640 Assessment of solar applications for transfer of technology - A case of solar pump. J K Parikh (International Institute for Applied Systems Analysis, Laxenburg, Austria) (UNESCO, Conference on Solar Energy, London, England, May 1977) *Solar Energy*, vol 21, no 2, 1978, p 99-106 8 refs

For the large and increasing rural population in the developing countries, decentralized solar applications could be relevant. However, new solar technologies being currently developed in the laboratories have to be ultimately acceptable in the field. The conditions which have to be satisfied before the solar applications could be acceptable are discussed. The solar pump is examined in detail. A comparative techno-economic analysis is carried out for solar pumps and diesel pumps. Attention is given to an escalation of the diesel price and factors related to climate, geography, locale, and social and institutional environment, for two types of uses namely for drinking water and for irrigation. It seems unlikely that a solar pump could compete with the diesel engine before the costs are brought down by a factor of 20-50 for irrigation purposes. The issues discussed for the case of a solar pump are also relevant for other solar applications (Author)

A78-49641 * Theory and applications for optimization of every part of a photovoltaic system. D Redfield (RCA Laboratories, Princeton, N.J.) *Solar Energy*, vol 21, no 2, 1978, p 107-112 ERDA-NASA-sponsored research

A general method is presented for quantitatively optimizing the design of every part and fabrication step of an entire photovoltaic system, based on the criterion of minimum cost/Watt for the system output power. It is shown that no element or process step can be optimized properly by considering only its own cost and performance. Moreover, a fractional performance loss at any fabrication step within the cell or array produces the same fractional increase in the cost/Watt of the entire array, but not of the full system. One general equation is found to be capable of optimizing all parts of a system, although the cell and array steps are basically different from the power-handling elements. Applications of this analysis are given to show (1) when Si wafers should be cut to increase their packing fraction, and (2) what the optimum dimensions for solar cell metallizations are. The optimum shadow fraction of the fine grid is shown to be independent of metal cost and resistivity as well as cell size. The optimum thicknesses of both the fine grid and the bus bar are substantially greater than the values in general use, and the total array cost has a major effect on these values. By analogy, this analysis is adaptable to other solar energy systems (Author)

A78-49642 An analytic evaluation of the flux density due to sunlight reflected from a flat mirror having a polygonal boundary. F W Lipps and M D Walzel (Houston, University, Houston, Tex.) *Solar Energy*, vol. 21, no 2, 1978, p. 113-121 5 refs Contract No E(04-3)-1108

Computer algorithms for the flux density of reflected sunlight from a heliostat become an essential part of the optical simulation problem for the central receiver system. An exact analytic result is available for heliostats having polygonal boundaries. An analytical method for round heliostats is given in Appendix A, which is extremely complex and requires quartic roots. A useful numerical method is given in Appendix B for heliostats of arbitrary shape. A comparison is made between the analytic method and the Hermite function method, which is much faster but less accurate. The analytic method provides a basis for evaluating all other flux density calculations (Author)

A78-49643 Thermal conversion of solar radiation - Theoretical performance of collectors furnished with an absorbent selective surface. R Pasquetti and F Papini (Aix-Marseille I, Université, Marseille, France) *Solar Energy*, vol 21, no 2, 1978, p 129-138 8 refs Translation

The present study is concerned with the determination of the behavior of selective surfaces in thermal converters of solar energy. By means of an idealized model, the influence of various parameters such as selectivity, concentration ratio and working temperature on the efficiency of the collector is thus brought out. The study leads to an optimized selective surface for each condition of use, either by considering the instantaneous efficiency or, in a more realistic way, by introducing the daily efficiency of an installation. Furthermore, a 'temperature-concentration' diagram allows us to make an a priori estimation of the suitable value of the selectivity if the temperature and the concentration ratio are externally determined. It is also shown how convective phenomena have to be taken into account in the establishment of the characteristics of the collector (Author)

A78-49644 Optical properties of compound circular arc concentrators. R E Jones, Jr and G C Anderson (Lakehead University, Thunder Bay, Ontario, Canada) *Solar Energy*, vol 21, no 2, 1978, p 149-151 8 refs

The chief disadvantages of focusing solar radiation concentrators are that they require continual tracking to follow the sun, and that they do not collect diffuse radiation. The cylindrical reflector-type nonfocusing concentrators considered do not have these disadvantages. The design of a compound circular arc concentrator (CCAC) is discussed. The cylindrical compound parabolic concentrator (CPC) has two reflector surfaces. A description is presented of approaches for approximating the CPC by circular arcs. A numerical ray tracing technique is used to investigate the optical properties of the CCAC for several concentration ratios. It is found that the optical properties of the CCAC are at a disadvantage in comparison with the CPC, although less so for low concentrations. It is suggested that any decision to use the CCAC rather than the CPC design should be based on economic grounds. G R

A78-49645 Metal hydrides as chemical heat pumps. D M Gruen, M H Mendelsohn, and I Sheft (Argonne National Laboratory, Argonne, Ill.) *Solar Energy*, vol 21, no 2, 1978, p. 153-156 10 refs ERDA-sponsored research

Chemical heat pumps, as distinguished from other heat pumps, rely on chemical equilibria rather than mechanical compressors for their operation. Gruen and Sheft (1975) have proposed a two metal hydride chemical heat pump system using solar or any other appropriate energy source for space heating and cooling, refrigeration, and power production. A detailed description is presented of the refrigeration mode of operation for a two metal hydride chemical heat pump system. The derivation of general heat pump equations which may be applied to any pair of compounds, which depend on a linear relationship of $\ln P$ vs $1/T$ for their heat pump utility is also given. Attention is paid to basic physico-chemical properties of metal-hydrides and their application in an absorption refrigerator, the considered cooling cycle compared to a standard absorption refrigeration cycle, and the coefficient of performance. G R

A78-49646 A novel solar collector. Y Caouris, R Rigopoulos, J Tripanagnostopoulos, and P Yianoulis (Patras, University, Patras, Greece) *Solar Energy*, vol 21, no 2, 1978, p 157-160 6 refs

In the proposed solar collector design, the working fluid (liquid) circulates above the absorbing surface and absorbs the IR radiation which is emitted by it. There is, therefore, no need for the selective black surface of the conventional flat solar thermal collector. The proposed collector consists of a number of plates, which are transparent in the visible and near IR part of the spectrum and have small thermal conductivity. The last surface is black and absorbs the solar radiation. A working liquid is used which has high transmittance in the visible and near IR part of the spectrum and nearly zero transmittance at longer wavelengths. The mathematical relations

manganese porphyrins and phthalocyanins with quinone. While each of the three processes has been reproduced to some extent in vitro, light harvesting antenna efficiencies are lowered by concentration quenching. M L

A78-48401 # New models of solar components and prospects of their optimization (Norye modeli solnechnykh elementov s perspektivy ikh optimizatsii) N S Lidorenko, V M. Evdokimov, A K Zaitseva, M M Koltun, S V Riabikov, and D S Strebkov (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR) *Geliotekhnika*, no 3, 1978, p 3-17. 34 refs In Russian

Consideration is given to the theory of solar cells with 'built-in' electric fields. The development of a method for determining impurity concentration profiles which would optimize the accumulation of carriers from the doped layer is discussed. Attention is given to infrared-transparent solar cells and to cells with two-sided sensitivity. The use of solar concentration techniques to increase the efficiency of solar arrays is discussed. Different types of matrix multijunction cells with various p-n junction configurations are described. The possibility of producing solar cells on the basis of the volume photovoltaic effect is discussed. B J

A78-48402 # Photoelectric properties of the thin-film pCdTe-nCdS heterojunction (Fotoelektricheskie svoistva plenochnogo pCdTe-nCdS-geteroperekhoda) S A Azimov, Sh A Mirzagatov, and D T Rasulov (Akademii Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR) (*Vsesoiuznaia Konferentsiia po Ispol'zovaniu Solnechnoi Energii, Ashkhabad Turkmen SSR, Sept 1977*) *Geliotekhnika*, no 3, 1978, p 18-24. 13 refs In Russian

A study was performed to evaluate the spectral distribution of the collection coefficient, Q, of the thin-film pCdTe-nCdS heterojunction (a possible solar cell element) for different thicknesses of the wideband upper layer of CdS, the photo-volt-ampere characteristics were also determined for different levels of illumination. It is found that Q increases with increase in thickness of the CdS layer, at 5 microns, a Q of 0.94-0.95 is obtained in the 0.56-0.8 micron wavelength region. An analysis of photoelectrical and electrophysical measurements has shown that there is an i-region in the pCdTe-nCdS heterojunction. This i-region appears to be due to the vaporization of cadmium from the surface of sublimated CdTe films during cooling. B J

A78-48403 # Optimization and design calculation of a radiative cooling system for a Stirling-engine energy unit (Optimizatsiia i raschet sistemy teplosbora izlucheniem energoustanovki s dvigatelem Stirlinga) G Ia Umarov, L M Drabkin, and V S Trukhov (Tashkentskii Institut Zheleznodorozhnogo Transporta, Akademii Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR) *Geliotekhnika*, no 3, 1978, p 25-30. In Russian

The paper presents a method of specific-area optimization for the radiative cooling-fin system of a Stirling-engine solar energy unit in a planetary environment. An expression is obtained which enables optimization by means of the most easily obtainable experimental characteristics of the Stirling cycle. A method for the design and calculation of a one-dimensional radiator of tube-membrane type is developed on the basis of results of Stirling-cycle optimization. B J

A78-48404 # Characteristics of silicon photovoltaic cells with inversion layers (Kharakteristiki kremniyevykh fotoprebrazovatelei s inverzionnym sloem) B I Gil'man, V V Kasatkin, Iu V Sorokin, Iu B Skokov, and M B Zaks *Geliotekhnika*, no 3, 1978, p 31-38. 9 refs In Russian

Experiments were performed to investigate the output characteristics of silicon solar cells with doped inversion layers, the function of these layers is to collect minority carriers in the space charge region. Output current and the shape of the volt-ampere characteristics are studied as a function of initial voltage, intensity and wavelength of illumination, as well as the geometrical dimensions of inversion regions. Spreading of the photocurrent in the inversion

layer plays a dominant role in the conversion process. Ways to raise the energy conversion efficiency of this type of solar cell are discussed. B J

A78-48405 # Composite heliostats of high-power solar energy systems (Sostavnye geliostaty moshchnykh solnechnykh ustanovok) R A Zakhidov and A Sh Kholzhaev (Akademii Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe i Tekhnologicheskoe Biuro Nauchnogo Priborostroeniia, Uzbek SSR) *Geliotekhnika*, no 3, 1978, p 39-44. 8 refs In Russian

A mathematical model has been developed for investigating the mutual shading of individual heliostats in a paraboloidal multiheliostat system. On the basis of an analysis of shading effects, formulas are obtained for the optimization of the dimensions and mutual positioning of heliostats. Computer calculations are used to determine optimization relations which can be used to establish operational modes and possible power losses for the solar system. The model can be applied to the analysis and optimization of solar tower systems. B J

A78-48406 # Determination of contact thermal resistances (Opredelenie kontaknykh teplovykh soprotivlenii) Ch Agabaev and N Obezakhatov (Akademii Nauk Turkmenkoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR) *Geliotekhnika*, no 3, 1978, p 51-55. In Russian

An experiment was conducted to investigate heat transfer between copper plates for the following conditions: (1) plates in contact, (2) plates separated by thin air gaps (0.5-1.0 mm), (3) plates separated by electrical insulation, and (4) plates separated by layers of scale. The heat source was an electric furnace and the test temperature range was 300-1000 K. Values of specific heat flux and total thermal resistance are presented for the four schemes of contact and for different temperatures. Total thermal resistance and temperature jumps are obtained for a heat flux of 130,000 W/sq m. The types of plate contact examined here are such that may be encountered in different types of solar energy systems, and particularly in solar thermoelectric generators. B J

A78-48407 # Dependence of the thermal engineering characteristics of a glassed solar regenerator on the cross section of the air slit (Zavisimost' teploekhnicheskikh kharakteristik osteklennoho gelioregeneratora ot secheniia shcheli dlia vozdukhha) A Kakabaev, A Khandurdyev, O Klyshchaeva, and O Tuiiev (Akademii Nauk Turkmenkoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR) *Geliotekhnika*, no 3, 1978, p 56-58. In Russian

The paper presents experimental results on the intensity of evaporation and temperature of the solution in a solar regenerator for different upper cross sections of the air slit between the covering glass and the surface of the regenerator. The amount of evaporated moisture is studied as a function of solar irradiation intensity and air gap width (0.08 and 0.05 m). Empirical relationships are determined for the amount of evaporated moisture and for the temperature of the solution at the end of the regenerator. These relationships can be used to optimize the operation of this type of solar regenerator, optimization is achieved by regulating the cross section of the air gap. B J

A78-48408 # Principles of the mathematical modeling of the energy structure of solar radiation regimes (Osnovy matematicheskogo modelirovaniia energeticheskoi struktury rezhima solnechnoi radiatsii) R B Salieva (Tashkentskii Elektrotekhnicheskii Institut Sviazi, Tashkent, Uzbek SSR) *Geliotekhnika*, no 3, 1978, p 62-71. 11 refs In Russian

A statistical modeling procedure is presented for studying solar radiation distribution on the earth surface. The procedure is based on periodic observations of normal-incidence insolation, but can also be used to construct models for other components of solar radiation, including total, scattered, and reflected. The approach is a probabilistic one, viewing the influx of solar radiation as a stationary stochastic temporal process. The procedure can be used to evaluate performance indices for various solar energy systems. B J

A78-48463 # The development of a low cost turbojet engine in the 1 kN thrust class W C Elrod, H E Wright (USAF, Institute of Technology, Wright-Patterson AFB, Ohio), and D B Wilkinson (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Joint Propulsion Conference, 14th, Las Vegas, Nev., July 25-27, 1978, AIAA Paper 78-966* 9 p 5 refs

Turbojet engines in the 1 kN class were developed by the conversion of two different sizes of turbosuperchargers into turbojet engines. Each engine was run from idle to maximum allowable turbine inlet temperature (1250K). The larger engine was derived from a turbosupercharger typically found on diesel truck engines while the smaller unit was from one used on the sports car size internal combustion engines. The larger unit using JP-4 type fuel produced 0.33 kN thrust dry and 0.483 kN thrust with afterburner. The afterburner was a dump type combustor using only the natural recirculation zone produced by the step change in diameter as the flame holder. The smaller unit operating on gaseous hydrogen produced 0.15 kN thrust. The combustor was a conventional tube type unit with a catalytic converter located at its exit section.

(Author)

A78-48486 # Propulsion for future supersonic transports - 1978 status G B Evelyn, P E Johnson, and A Sigalla (Boeing Commercial Airplane Co., Seattle, Wash.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Joint Propulsion Conference, 14th, Las Vegas, Nev., July 25-27, 1978, AIAA Paper 78-1051* 14 p 13 refs

Results of several studies that have taken place since the cancellation of the United States SST program in 1971 have shown significant progress in the technology that may make such an airplane eventually possible. Advances in propulsion technology have been a strong element of this progress. The state of propulsion technology, as applicable to a future SST, is reviewed, with emphasis on the progress and changes that have occurred since 1971. The review includes discussion of the basic technology that affects thermodynamic and mechanical characteristics of supersonic engines, competitive types of engine cycles, the state of supersonic intake technology and candidate concepts, and supersonic engine nozzles. Emphasis is placed on the interactions of the propulsion system with the rest of the airplane and on the assessment of the propulsion system in terms of airplane performance and noise.

(Author)

A78-48505 Photovoltaic power generation. D L Pulfrey (British Columbia, University, Vancouver, Canada) New York, Van Nostrand Reinhold Co., 1978 230 p 240 refs \$16.95

The elements of photovoltaic power systems are examined, taking into account insolation, photovoltaic arrays for use in unconcentrated and concentrated sunlight, power conditioning and solar/nonsolar power plant interconnection, energy storage, present-day photovoltaic power systems, geosynchronous satellite solar power, and the institutional aspects of photovoltaic power development. Basic theory and present performance of solar cells are considered along with solar cells for unconcentrated sunlight systems, solar cells for concentrated sunlight systems, and the economic aspects of photovoltaic power systems. Attention is given to the solar cell equivalent circuit, the short circuit photocurrent, the conversion efficiency in large area solar cells, silicon solar cells, cadmium sulfide solar cells, inorganic semiconductors, organic semiconductors, gallium arsenide solar cells, and the cost of electricity from photovoltaic power systems.

G R.

A78-48519 Principles and applications of solar energy P N Cheremisinoff (New Jersey Institute of Technology, Newark, N.J.) and T C Regino (Pandullo Quirk Associates, New York, N.Y.) Ann Arbor, Mich., Ann Arbor Science Publishers, Inc., 1978 254 p 130 refs \$15

Historical aspects regarding the utilization of solar energy are considered along with questions concerning solar energy availability, thermal collection devices, thermal solar energy applications, the

photovoltaic generation of electricity, energy from the wind, ocean thermal gradient power, chemical conversion of solar energy, and biological conversion of solar energy. Attention is given to nonconcentrating collectors of the flat-plate type, liquid-cooled flat-plate collectors, air-cooled flat-plate collectors, evacuated tube types of nonconcentrating collectors, concentrating collectors, the heating of buildings, air systems, hydronic systems, the cooling of buildings, domestic water heating, solar irrigation, thermal generation of electricity, the Smith-Putnam wind turbine, photoelectrolysis, electrochemical photovoltaic cells, hydrogen utilization, the production of photosynthetic biomass, solid and animal wastes as biomass, and the conversion of biomass to energy.

G R

A78-48535 # Free convection across inclined air layers with one surface V-corrugated S M Elsherbiny, K G T. Hollands, and G D. Raithby (Waterloo, University, Waterloo, Ontario, Canada) *ASME, Transactions, Journal of Heat Transfer*, vol 100, Aug 1978, p 410-415 26 refs Contract No EY-76-C-02-2597

Experimental measurements are presented for free convective heat transfer across inclined air layers, heated from below, and bounded by one V-corrugated plate and one flat plate. The measurements covered three values for the ratio A (averaged plate spacing to V-height), namely, A = 1, 2.5 and 4. They also covered angles of inclination with respect to the horizontal of 0, 30, 45 and 60 deg, and a Rayleigh number range of (10-4) million. The study proves, both theoretically and experimentally, that the free convective heat transfer is essentially the same, regardless of whether the V-corrugated plate is above or below. It was found that for the same average plate spacing, L, the convective heat losses across air layers bounded by one V-corrugated and one flat plate are greater than those for two parallel flat plates by up to 50 percent for the range studied. Experimental results are given as plots of Nusselt number versus Rayleigh number. A correlation equation is given for Nusselt number, Nu, as a function of the above-mentioned parameters.

(Author)

A78-48550 # An assessment of overburden stability in the in-situ gasification of Texas lignite T W Thompson, T F Edgar, and K E Gray (Texas, University, Austin, Tex.) *American Society of Mechanical Engineers, Petroleum Mechanical Engineering and Pressure Vessels and Piping Conference, Mexico City, Mexico, Sept 19-24, 1976* ASME, Transactions, Journal of Pressure Vessel Technology, vol 100, Aug 1978, p 285-290 14 refs Research supported by the Texas Utilities Co., Atlantic Richfield Co., Continental Oil Co., Dow Chemical Co., Du Pont de Nemours and Co., Mobil Oil Corp., Shell Development Co., and NSF.

In-situ gasification can be competitive with shaft mining for the exploitation of coal at depths too deep for surface mining. The lignite deposits in Texas may be well suited to this process because of their high reactivity, comparatively high field permeabilities and closeness to industrial demand centers. Controlled operation of a gasification facility demands a knowledge of the likely behavior of the overburden and other surrounding rocks. Fracture or collapse of the roof rock can lead to excessive gas loss, water influx and subsidence effects. The overburden in much of Texas is weak and poorly compacted. Early roof collapse seems inevitable, and substantial upward caving may occur. Subsidence could be significant if high extraction ratios are used.

(Author)

A78-48557 # Calculation of unsteady two-dimensional magnetohydrodynamic flows in a radial channel (Raschet nestatsionarnykh dukhmernykh magnitogidrodinamicheskikh techenii v radial'nom kanale). N P Gridnev and S S Katsnel'son *Magnitnaia Gidrodinamika*, Apr-June 1978, p. 77-82 9 refs In Russian

The present analysis deals with the situation where the flow generated in a cylindrical tube by the passage of a shock wave through an inert gas with an alkali metal addition issues into a disk-shaped MHD channel. The complex interaction of the expanding plasma flow with the magnetic field is analyzed, and a finite-difference scheme of third order accuracy, with a uniform time step, is proposed for calculating the shock interactions. For illustration,

the flow is calculated for conditions where both the magnetic Reynolds number and the Hall parameter are small V P

A78-48558 # **Allowing for the action of the yoke of an induction MHD machine by introducing new boundary conditions (Uchet deistviia iarma lineinoi induktsionnoi MGD-mashiny vvedeniem novykh granichnykh uslovii)** A Ia Vilnits *Magnitnaia Gidrodinamika*, Apr-June 1978, p 87-96 19 refs In Russian

In the present paper, the action of the magnetic yoke of a linear MHD machine is expressed by introducing a new type of boundary conditions in the form of a stepped normal induction component. This, together with the passage to a 'thin' working fluid at the limit, makes it possible to reduce the regions of both the working fluid and the yoke to lines (traces) with specified boundary conditions, assuming all the while that the Laplace equation is satisfied everywhere else. The new boundary conditions can be obtained by Fourier transforms with respect to the longitudinal coordinate. For an infinite yoke, the solution is shown to be rational. The case of a finite yoke leads to an integral equation or to an infinite system of algebraic equations V P.

A78-48559 # **Optimization of a diagonal MHD-channel (Optimizatsiia diagonal'nogo MGD-kanala)** D A But, I I Doperchuk, and S M A Koneev *Magnitnaia Gidrodinamika*, Apr-June 1978, p 110-116, 13 refs In Russian

In the present paper, a diagonal MHD-channel is optimized with allowance for transient turbulent boundary layers and boundary layer separation, placing constraints on the channel geometry, the magnetic field, and some other parameters of the problem. Optimization is achieved by a nonlinear programming method, termed the method of moving tolerances, modified to improve the convergence of the iterations. It is shown that the value of the conversion coefficient can be increased by 10 to 12% by rational profiling of the channel and electrode walls. V P

A78-48733 **Research conducted by Gaz de France on hydrogen (Les recherches menées par le Gaz de France dans le domaine de l'hydrogene)** G Donat, A Lecoanet, and J-P Roncato (Gaz de France, Paris, France) (*Association Technique de l'Industrie du Gaz en France, Congrès, Vichy, France, Sept 1977*) *Institut Français du Pétrole, Revue*, vol 33, May-June 1978, p 391-416 11 refs In French

The surveyed research suggests that thermochemical procedures for generating hydrogen from water are not likely to be competitive with electrolytic techniques, which are thought to show good prospects for improvement. Computer and economic studies of thermochemical cycles are described. The stockpiling of hydrogen in caverns or in porous geological formations is considered, and the transport and utilization of hydrogen is examined M L

A78-48813 **Development co-operation and solar energy** T Thalhammer, G Prast, J Langerhorst (Philips' Gloeilampen fabrieken, Philips Research Laboratories, Eindhoven, Netherlands), and W Floor (Ministerie van Buitenlandse Zaken, The Hague, Netherlands) *International Journal of Energy Research*, vol 2, July-Sept 1978, p 211-228 11 refs

The energy needs of some developing countries are discussed with reference to the possible use of solar energy in the period up to 1985. Various technologies are examined, and cooperative programs between industrialized and developing countries for the purpose of implementing the technologies are considered. Some recommended systems include small thermal electric generators powered by concentrated sunlight at an operating temperature of about 300 C, the principal application being for irrigation pumps in India and Pakistan, small absorber cooling systems for India and Pakistan, drinking-water purification for Niger, Pakistan, Senegal, and Upper Volta, battery-charging systems for India and Pakistan, reforestation for firewood production in the Sahel countries M L

A78-48814 **Solar wall performance** J Cash (College of Technology, Dublin, Ireland) *International Journal of Energy Research*, vol 2, July-Sept 1978, p 229-245 9 refs

The thermal behavior of small solar walls consisting of an opaque inner leaf and a transparent outer leaf is characterized. The data support application of one-dimensional heat transfer theory which describes thermal behavior in terms of the wall thermal transmittance, a solar gain factor, and an environmental temperature. Solar radiation measurements, environmental temperatures, and determinations of the average solar gain and the instantaneous solar gains are reported. Limitations of data obtained from small test units and modifications of solar wall design are considered M L

A78-48816 **Effect of nonideal conditions on the electrical performance of Faraday MHD generators** R Jayakumar, D K Goyal, S Ghosh, and V K Rohatgi (Bhabha Atomic Research Centre, Bombay, India) *International Journal of Energy Research*, vol 2, July-Sept 1978, p 265-280 18 refs

A two-dimensional analysis of the current flow in a MHD generator is used to characterize nonideal conditions in terms of internal resistance, Hall voltage, and uniformity of current distribution. In particular, the effects of (1) temperature profile along the Faraday direction in the plasma, (2) current bunching on cathode surfaces due to phenomena like arc spots, and (3) electrical leakage between adjacent electrodes due to finite resistance of the insulator segments are investigated. It is found that cold boundary layers near metallic electrode surfaces tend to relieve current concentration and that the electrical performance of a MHD generator is not adversely affected by current leakage along insulator segments for small insulator conductivities. The optimum resistivity of wedge-shaped electrodes for obtaining uniform current distribution in the duct has been calculated for various temperature profiles M L

A78-48817 **Theoretical analyses of some simple wave power devices** N A Tornqvist (Helsinki, University, Helsinki, Finland) *International Journal of Energy Research*, vol 2, July-Sept 1978, p 281-294 14 refs. Research supported by the Academy of Finland

A theoretical analysis of the hydrodynamic properties of a few ideal devices which utilize vertical energy-absorbing plates is presented. A proposed system which uses vertical elastic plates perpendicular to incoming waves is described. The system includes a rather immobile wave reflector situated about a quarter of a wavelength behind the first plate. The optimal force field is considered, the spectrum of appropriate wavelengths can be broadened by adding more swinging plates, so that efficiencies of 80-100% are theoretically attainable for a wavelength spectrum extending over an order of magnitude M L

A78-48854 **Possible similarity solutions for free convection boundary layers adjacent to flat plates in porous media** C H Johnson and P Cheng (Hawaii, University, Honolulu, Hawaii) *International Journal of Heat and Mass Transfer*, vol 21, June 1978, p 709-718 20 refs NSF Grant No GI 38319, Contract No EY-76-C-03-1093

The necessary and sufficient conditions under which similarity solutions exist for free convection boundary layers adjacent to flat plates in porous media are examined in this paper. For steady free convection it was determined that similarity solutions exist for vertical plates when the temperature difference between the wall and the environment varies according to power-law and exponential forms and for horizontal plates according to power-law forms. Also, several very specific solutions exist for unsteady free convection about flat plates in a porous medium. For a stable thermally stratified environment similarity solutions exist only for steady free convection about vertical plates (Author)

A78-48910 **Magnetic confinement fusion energy research** H Grad (New York University, New York, N Y) *International Journal of Fusion Energy*, vol 2, Summer 1978, p 3-38 31 refs Contract No EY-76-C-02-3077

Controlled thermonuclear research and magnetic fusion energy characteristics are surveyed. The contribution of mathematical analysis to an understanding of these processes is considered with attention to the stimulatory effect generated by fusion problems for

the field of pure mathematics. The present status and future projections of the extent of understanding of magnetic confinement fusion are discussed. Mathematical examples include treatment of the adiabatic problem and generalized differential equation in a simple geometry, isolation and generalized adiabatic constraints, and resistive diffusion. M L

A78-48975 The 'Windmill Case' - Facing up to appropriate technology. T J Lodge (Department of Community Development, Toledo, Ohio) *Environmental Affairs*, vol 6, no 4, 1978, p 491-510 79 refs

The 1977 NY Public Service Commission decision concerning the Windmill Case is discussed with attention to the organization of the electric utility industry and the response of the industry to innovative small-scale power-generation techniques. The Windmill Case involves generation of electricity sufficient for the inhabitants of a NYC apartment house by means of a windmill located on the building roof. While the building inhabitants, who form a co-op, did not object to the minimum demand charge imposed by the utility, the co-op did object to the minimum customer charge. The relevance of the Gainesville Utility Case is considered, the implications of the three stages of the modern electricity market are examined, and the consequences of windmill proliferation for utilities and windmill owners are explored. M L

A78-49000 Energy balance for ethyl alcohol production from crops. J G da Silva, G E Serra (São Paulo, Universidade Estadual, São Paulo, Brazil), J R Moreira, J Goldemberg (São Paulo, Universidade, São Paulo, Brazil), and J C Gonçalves. *Science*, vol 201, Sept 8, 1978, p 903-906 18 refs

Energy requirements to produce ethyl alcohol from three different crops in Brazil (sugarcane, cassava, and sweet sorghum) were calculated. Figures are presented for the agricultural and industrial phases. The industrial phase is always more energy-intensive, consuming from 60 to 75 percent of the total energy. Sugarcane is the more efficient crop for ethyl alcohol production, followed by sweet sorghum and cassava from a net energy viewpoint. The utilization of sweet sorghum stems might increase the total energy gain from this crop to almost the same level as sugarcane. Cassava has a lower energy gain at the present state of agriculture in Brazil. (Author)

A78-49038 # Dynamic characteristics of a system consisting of a free-piston diesel and an MHD generator (Dinamicheskie kharakteristiki svobodnoporshnevogo dizel'-MGD-generatora). B M Antonov, V A Bashkatov, Iu M Kirillov, I N Postnikova, S S Safonova, and E. E Shpil'rain (Akademiya Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) *Teplofizika Vysokikh Temperatur*, vol 16, May-June 1978, p 611-619 5 refs In Russian

The paper proposes a method for calculating the dynamic characteristics of a system consisting of a free-piston diesel engine and a liquid-metal MHD generator. Results of the computation of the dynamic, thermodynamic and cost-efficiency characteristics of the system are presented for the following initial conditions: independent excitation, a channel induction of 2 T, active electrical loading, a load coefficient of 0.95, a rectangular cross section of the MHD channel of 5 mm x 20 mm, and three different piston areas, 312, 467, and 623 sq mm. B J

A78-49039 # Construction of a mathematical model of the arc-discharge operational mode of the electrodes of an MHD generator (K postroeniiu matematicheskoi modeli dugovogo rezhima raboty elektrodov MGD-generatora). L P Poberezhskii. *Teplofizika Vysokikh Temperatur*, vol 16, May-June 1978, p 620-623 12 refs In Russian

A78-49155 # Attitudes and behavior of the general public regarding different forms of energy production. C Krebsbach, J Scharioth, and I-G Schmid-Jorg. *Battelle Information (Frankfurt)*, June 1978, p 20-25.

The goals, organization, and some results of a survey to determine the attitudes of the general public towards different forms of energy production in West Germany are reported. A checklist of research topics such as 'What are the main arguments given by members of the public to substantiate their attitude for or against specific forms of energy production' is provided. The survey was conducted in Voerde on the Lower Rhine, Mannheim/Ludwigshafen, and the rural district of Emmendingen. Expressed attitudes towards nuclear power plants, coal, oil, water, gas, and sun derived energy are summarized, and factors affecting attitudes and the firmness with which these attitudes are held are examined. M L.

A78-49159 # The heat distribution in the Stechlin Lake as a result of anthropogenic effects (Die Warmeverteilung im Stechlinsee in Auswirkung anthropogener Beeinflussung). A Klamt (Meteorologischer Dienst, Forschungsinstitut für Hydrometeorologie, Berlin, East Germany) *Zeitschrift für Meteorologie*, vol 28, no 3, 1978, p 165-169 In German

With reference to a 7-year measuring series the temperature field at the water surface formed by the cooling water circuit of the nuclear power plant is described. From a comparison of the measured and the theoretical cooling curves - calculated on the assumption of the presence of heat exchange only between water surface and atmosphere - the portion of the vertical heat flux can be obtained. The influence of the stratification inside the lake and of the wind is investigated. (Author)

A78-49170 The solar timetable. D. Hayes (Worldwatch Institute, Washington, D C) *Environment*, vol 20, July-Aug 1978, p 6-13, 38, 39-36 refs

A timetable for introduction and development of solar, renewable, and electrical energy sources is presented as an attempt to describe a feasible course for moving rapidly toward increased reliance upon renewable energy. Heating and cooling of homes is discussed with attention to passive and active systems. Wood, ethanol/methanol, and methanol are considered as examples of renewable fuels. The prospects for generating electricity by hydro-power, wind power, and photovoltaic cells are examined. Attitudes and obligations required for meeting the timetable for these classes of energy sources are indicated. M.L.

A78-49171 The case for CASES. W R Powell (Johns Hopkins University, Laurel, Md.) *Environment*, vol 20, July-Aug. 1978, p 14-20, 40, 41. Contracts No W-31-109-38-3995, No. N00017-72-C-4401

The paper describes the Community Annual Energy Storage System (CASES), a computer-simulated thermal utility plan for providing the heating and cooling required by a whole community through the storage of summer heat and winter cold for use in the opposite season. Although CASES has not been put into operation, all the necessary equipment already exists and is commercially available. CASES provides cooling and heating for buildings by means of two water pipes which distribute water from cold and warm water storage facilities. Warm water produced during summer can be stored in an aquifer or, if an aquifer is unavailable, the cold water returned to the central CASES facility is heated and passed back to the community, the needed heat can be obtained from a separate water pond through the use of an ice machine. M.L.

A78-49246 Observation of a forbidden line of Fe XX and its application for ion temperature measurements in the Princeton Large Torus tokamak. S Suckewer and E Hinnov (Princeton University, Princeton, N.J.) *Physical Review Letters*, vol. 41, Sept 11, 1978, p 756-759 14 refs. Contract No EY-76-C-02-3073.

A78-49288 The development of beta-alumina for use in electro-chemical cells - A survey. G J May (Chloride Silent Power, Ltd, Astmoor, Ches., England) *Chemical Society, International Symposium on Molten Electrolytes and High Temperature Batteries, Brighton, England, Sept. 22, 23, 1977* *Journal of Power Sources*, vol 3, Aug 1978, p 1-22 64 refs

which describe the operational processes in the collector are considered and the efficiency of the collector is calculated. Attention is given to the possibility to use the described principle of operation also in other applications. G R

A78-49659 Oil spill recovery with magnetically retrievable sorbents - Preliminary performance report of MAG-1 A 24-foot magnetic type recovery vessel for light oils J E Turbeville In Oceans '77, Annual Combined Conference, 3rd, Los Angeles, Calif., October 17-19, 1977, Conference Record Volume 2

New York, Institute of Electrical and Electronics Engineers, Inc., Washington, D C., Marine Technology Society, 1977, p 33E-1 to 33E-6

A portable oil spill recovery vessel which incorporates magnetic principles for the retrieval process was completed in the spring of 1977. An integral part of the project was the lab research required to obtain the optimum formulation for a magnetically retrievable sorbent material. The following properties were considered to be essential for the 'ferrofoam' product: (1) high magnetic force to weight ratio, (2) positive flotation on water, (3) discriminative absorption of oil vs water even after extended periods of use, (4) high percentage of oil retention in saturated foam prior to wringing, low percentage of oil retention after wringing, (5) no significant loss of physical characteristics after continued wringing, and (6) harmless to marine life and ocean ecology. Details of ferrofoam production and of test procedures employed to analyze the essential operational functions of the recovery unit are presented. Sorbent requirements, oil recovery rates, limitations, and a cost-to-benefit analysis are discussed in detail. B J

A78-49662 Interpretation of oceanographic data for the design of ocean thermal energy conversion plants. L F Lewis (US Department of Energy, Washington, D C.) and J W Mavor, Jr (Woods Hole Oceanographic Institution, Woods Hole, Mass.) In Oceans '77, Annual Combined Conference, 3rd, Los Angeles, Calif., October 17-19, 1977, Conference Record Volume 2

New York, Institute of Electrical and Electronics Engineers, Inc., Washington, D C., Marine Technology Society, 1977, p 41B-1 to 41B-7 16 refs ERDA-supported research

The design of an OTEC plant requires oceanographic measurements at the specific site to a fine degree of detail over a time interval and with a frequency sufficient to assure optimum configuration and performance. A part of the design process is the continuous evaluation of the oceanic data and matching it to the needs of design, construction, and test. The present paper describes a program underway to assess available ocean data (pertaining to such parameters and phenomena as temperature, extreme events, waves, internal waves, biofouling, and corrosion and erosion), to design a plan and schedule to match ocean data to OTEC design, to match existing data to this plan, and to recommend a program of additional measurements. B J

A78-49663 OTEC - An emerging program of significance to the marine community C E Rudiger, Jr and L O Smith (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.) In Oceans '77, Annual Combined Conference, 3rd, Los Angeles, Calif., October 17-19, 1977, Conference Record Volume 2

New York, Institute of Electrical and Electronics Engineers, Inc., Washington, D.C., Marine Technology Society, 1977, p. 41C-1 to 41C-7 8 refs

ERDA intends to conduct a commercial demonstration of the Ocean Thermal Energy Conversion (OTEC) concept in 1984. This paper describes the ERDA program plan leading to the demonstration, discusses some commercialization considerations, and gives special attention to two of the major steps in the plan - OTEC-1 (design of a closed-cycle power plant) and OTEC-100 (selection of hull shape). Consideration is also given to cycle efficiencies and several key marine-technology issues. Among the latter are biofouling and its potential impact on heat exchanger performance, the cold water pipe (OTEC's major ocean structure), and the heavy marine construction aspects of an OTEC plant. B J

A78-49664 Ocean thermal energy conversion heat exchanger biofouling - Strategies of control P. C. Springer (Lockheed Ocean Laboratory, San Diego, Calif.) In Oceans '77, Annual Combined Conference, 3rd, Los Angeles, Calif., October 17-19, 1977, Conference Record Volume 2

New York, Institute of Electrical and Electronics Engineers, Inc., Washington, D C., Marine Technology Society, 1977, p 41D-1 to 41D-4 6 refs.

The potential effect of biofouling on OTEC heat exchanger performance is considered. A brief review is presented of some of the candidate biofouling control systems, including chlorination, Amertap (a continuous tube-cleaning system that circulates sponge rubber balls), a shuttle brush system, biocidal soak, toxic impregnation, slurries, screening, and a number of experimental countermeasures. Factors considered in evaluating the suitability of these countermeasures for OTEC are described, and areas of research that must be addressed are identified. B J

A78-49666 Deep ocean inflatable pipe A L James (SEACO, Inc., Kailua, Hawaii) and J G Blackinton (Hawaii University, Honolulu, Hawaii) In Oceans '77, Annual Combined Conference, 3rd, Los Angeles, Calif., October 17-19, 1977, Conference Record Volume 2

New York, Institute of Electrical and Electronics Engineers, Inc., Washington, D C., Marine Technology Society, 1977, p POSTER-F-1 to POSTER-F-6 7 refs. Research supported by the University of Hawaii

The concept of a large-diameter inflatable pipe for open ocean upwelling and OTEC applications is discussed. The pipe is a double-wall, honeycombed structure of flexible material. Water fills the cavity between the walls, pressurizing this water inflates the pipe which produces a stiff structure. Cold water is pumped to the surface through the cavity bounded by the inner wall. The inflatable pipe offers the advantages of ease of installation and noncatastrophic buckling. Pipe geometry and inflation-induced loads are analyzed, and a preliminary bending analysis is performed. Model tests are compared with the analysis, substantiating the feasibility of the concept. B J

A78-49669 Generation of thermonuclear neutrons by laser action on a conical target V I Vovchenko, A S Goncharov, Iu S. Kas'ianov, O V Kozlov, I K Krasiuk, A A Maliutin, M G Pastukhov, P P Pashinin, and A M Prokhorov (Akademii Nauk SSSR, Fizicheskii Institut, Moscow, USSR) (ZHETF Pis'ma v Redaktsiiu, vol 26, Nov 5, 1977, p 628-630) JETP Letters, vol 26, Nov 5, 1977, p 476, 477 Translation

Experiments were performed on laser-beam compression of a deuterium-filled target consisting of conical cavities pressed into lead and closed with a lamsan polyester shell 5 microns thick and radius of curvature of 17 mm, the same as the dimension of the cone generator. The cone apex angle was 53 deg. The radiation was focused by a lens with $f = 30$ cm. The largest neutron yield of about 26,000 neutrons was recorded when laser radiation of energy 70 J and duration 25 nsec was focused on a target at 1 atm. An estimate shows that 8-14% of the laser radiation energy should be converted into energy of the compressed plasma. Shortening the laser pulse duration to 5 nsec while decreasing total energy to 30 J led to nearly complete vanishing of neutrons. P T H

A78-49731 # Use of a field bench for testing turbojet engines (Utilizzazione di un banco campale per la prova di turbomotori). A Russo, A Colantonio (Aeronautica Militare, Rome, Italy), and G Torella (Napoli, Università, Naples, Italy) Associazione Italiana di Aeronautica e Astronautica, Congresso Nazionale, 4th, Milan, Italy, Sept 19-23, 1977, Paper 48 p 7 refs. In Italian

The paper describes the use of a field test bench for taking measurements of the thermodynamic cycle of aircraft turbojet engines. The guiding concept in selecting the instrumentation was to use a minimum of sensors without sacrificing measurement accuracy and reliability. Two attached sensors were used, consisting of two thermocouples, of which one furnished data on the static temperature downstream of the compressor and the second measured the static temperature downstream of the turbine. The test bench, sensor, and other instrumentation are described, and the method of determining the cycle from the measurements is explained. P T H

A78-49781 * # A laser-powered flight transportation system A Hertzberg, K C Sun (Washington, University, Seattle, Wash), and W S Jones (Lockheed Missiles and Space Co, Inc, Palo Alto, Calif) *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Conference, Los Angeles, Calif, Aug 21-23, 1978, Paper 78-1484* 31 p 28 refs Grant No NGL-49 002 044

Laser energy transmitted from a solar-power satellite via a set of relay satellites is used to power a cruising air transport, i.e., a laser-powered airplane. The result is a nearly fuelless pollution-free flight transportation system which is cost competitive with the fuel-conservative airplane of the future. The major components of this flight system include a laser-power satellite, relay satellites, laser-powered turbofans, and a conventional airframe. The relay satellites are orbiting optical systems which intercept the beam from a power satellite and refocus and redirect the beam to its next target. (Author)

A78-49802 * # The solar power satellite concept - A space program perspective. C C Kraft, Jr (NASA, Johnson Space Center, Houston, Tex) *Journal of Energy*, vol 2, July-Aug 1978, p 193-195

The Space Shuttle will reduce the cost of transportation to space from thousands of dollars per pound to hundreds of dollars per pound. Studies of future systems indicate that these costs may be further reduced to tens of dollars per pound by using large space freighters, which would be required to build solar power satellites. It is pointed out that the Space Shuttle will provide a versatile tool in the 1980's to support the exploration of the solar power satellite concept as well as other space programs of the future. Three apparently different applications, related to materials processing in space, advanced satellite communications, and solar power satellites, have a number of common requirements. These include the need for large solar power arrays in space and/or the need to construct large systems in space. Consequently, a space program which includes development of the techniques for large power supplies and structural systems provides the basis for selecting and implementing any or all of these promising applications. G R

A78-49803 * # SPS cost considerations. G R Woodcock (Boeing Aerospace Co, Ballistic Missiles and Space Div., Seattle, Wash) *Journal of Energy*, vol 2, July-Aug. 1978, p. 196-202. Contract No NAS9-15196.

Recent solar power satellite (SPS) system definition studies have emphasized cost estimation for the operational phase of an SPS program, in order to assess economic practicality of SPS. A cost analysis approach is described. Cost results for a silicon photovoltaic SPS are reported, showing SPS costs from \$1700 to \$2700 per kilowatt and busbar power costs from 3 cents to 7 cents per kilowatt-hour. Rationales behind the estimates are discussed. (Author)

A78-49805 # Particle trajectories in swirling flows. R P. Dring and M Suo (United Technologies Research Center, East Hartford, Conn). *Journal of Energy*, vol 2, July-Aug 1978, p. 232-237 8 refs

The ability to utilize fuels which form particulate matter upon combustion (e.g., coal) in a gas turbine depends in part upon an understanding of the nature of particle trajectories in swirling flows. Although a number of investigators have studied specific flows or developed specific computational methods for particle trajectories in swirling flows, none have obtained solutions which are general in nature. In this paper a series of exact general solutions for trajectories of spherical particles in free-vortex swirling flow have been obtained in the absence of aerodynamic lift phenomena. As would be expected from related works, it has been found that for low particle Reynolds numbers (Stokes flow) the degree to which a particle either follows the flow streamlines or is centrifuged out across them is essentially described by a single dimensionless parameter, the Stokes number. For higher particle Reynolds numbers

the results can be presented in terms of two relevant parameters, one of which may be the Stokes number. Furthermore, even in this latter case the results indicate that the Stokes number is the dominant parameter. Based on these results a number of conclusions have been drawn on the nature of particle trajectories in turbine airfoil passages, and in centrifugal separators. (Author)

A78-49808 # Assessment of energy conservation using solar energy in Kansas. J T Pytlinski (New Mexico State University, Las Cruces, N Mex). *Journal of Energy*, vol 2, July-Aug 1978, p 250-253 7 refs

The continuous depletion of fossil fuels has created a situation which demands a gradual replacement of quickly depletable resources by nondepletable resources such as solar energy. Growth of the use of solar energy systems is related to several factors such as solar energy rights, system cost-effectiveness, availability of data actually tested for construction costs, maintenance requirements, and system reliability, integration of solar energy facilities into utilities load-management planning, and local and federal incentives, which when put together, control solar energy devices deployment. Several solar bills active in Kansas induce citizens in the state to use solar energy. A study of energy conservation in Kansas by using solar energy is conducted. It is concluded that although solar energy growth at present is impressive, solar energy will contribute little to energy conservation in the state by 1980. It is recommended to consider steps related to a mandatory use of solar energy in new state and federal buildings, and the mandatory use of solar energy in new dwellings when technically feasible. G R

A78-49838 Some preliminary results on the performance of a small vertical-axis cylindrical wind turbine. G Ahmadi (Pahlavi University, Shiraz, Iran) *Wind Engineering*, vol 2, no 2, 1978, p 65-74. 20 refs. Research supported by the Pahlavi University.

The performance of a newly developed small vertical-axis wind turbine with two sail blades is described. The model design is explained, and the effect of wind velocity and various blade angle settings on the power coefficient is studied. Maximum power coefficients for various conditions are plotted. Although the maximum efficiency of the model is only about 7%, it is suggested that the use of this wind energy convertor in remote rural areas of developing countries might be feasible due to the simplicity of the blade design and the relatively low cost of construction. M L.

A78-49839 Model and prototype performance characteristics of Savonius rotor windmill. M H Khan (Illinois, University, Urbana, Ill) *Wind Engineering*, vol. 2, no 2, 1978, p 75-85. 7 refs. Research supported by the Ford Foundation.

Model tests were conducted in a wind tunnel to arrive at an optimum configuration of Savonius rotor windmill. Effects of three design parameters, namely rotor shape, overlap between rotor blades, and separation gap between rotor blades, on the operating characteristics were studied. Rotor models with different combinations of the variable parameters were tested under three wind velocities to determine the configuration which would provide the best relative performance. From this study it was found that the optimum configuration was different from the standard Savonius design not only in the blade shape but also in the overlap distance between blades. On the basis of the results obtained from model tests, a prototype unit based on the optimum design configuration was built and tested on an open site. Results obtained from the tests of the full scale design are encouraging. The results have corroborated some of the original findings of Savonius. (Author)

A78-49840 Optimum design point geometry and performance of propeller type wind turbines. N H Juul (New York, State University, Buffalo, N.Y.). *Wind Engineering*, vol 2, no 2, 1978, p 86-102. 6 refs

The simple strip theory is used to develop the equations which are required to determine the optimum design point geometry and performance parameters of propeller type wind turbines. The optimum design point is defined by the conditions which maximize the power absorbed by each blade element along the blade. A

computer program is developed to calculate, for a given airfoil, the dimensionless optimum design point performance. The behavior of the important local and total turbomachinery parameters are studied. The range of tip speed ratios for which the strip theory is applicable is determined. The effects of viscosity, compressibility and tip losses are investigated. As an example, the results for wind turbines with NACA 4312 blades are presented graphically. These graphs may be used to choose the design point best suited for a desired application.

(Author)

A78-49841 Improvement of windmill efficiency by boundary layer control. J. S. Montes (Tasmania, University, Hobart, Australia). *Wind Engineering*, vol. 2, no. 2, 1978, p. 103-114. 7 refs.

The desirability of using boundary layer suction to increase the efficiency of conventional windmills is discussed. The rotation of the windmill blades provides a source of internal flow which can be utilized as a simple pump for the boundary layer suction, and a simplified mathematical model of the internal flow is presented. Equations are integrated numerically for some assumed values of the windmill geometrical parameters, and it is shown that, if certain conditions are assumed, advantages of some 20% in the operational efficiency of a variable pitch windmill and 33% for the fixed-pitch windmill can be obtained.

M. L.

A78-49842 The application of small wind powered generators in telecommunications and other high reliability systems. A. J. A. Hinsley and D. A. D. Smith (Pye Telecommunications, Ltd., Cambridge, England). *Wind Engineering*, vol. 2, no. 2, 1978, p. 115-126. 9 refs.

The use of 2-kW wind-powered generators of proven design to provide a highly reliable source of power for radio communication is discussed. Australian experience in using wind generators to provide power for remote sites is surveyed, and power requirements for different purposes are calculated. Engineering of systems is considered, and the total cost of wind-power generators, tower, energy storage, control equipment, and necessary buildings and foundations is estimated to be in the order of 8500 British pounds to supply a load of 200 watts. This form of wind-powered generation is economically justifiable only if the expenses involved in providing a connection with a cheap electricity source are considered in comparison.

M. L.

A78-49849 Potential lithium requirements for fusion power plants. J. N. Hartley, B. F. Gore, and J. R. Young (Battelle Pacific Northwest Laboratories, Richland, Wash.). *Energy* (UK), vol. 3, June 1978, p. 337-346. 16 refs.

The use of lithium by fusion power plants is discussed, and it is estimated that a 1000-GWe generating capacity (twice current U.S. generating capacity) would require 400,000 to 1,200,000 metric tons of natural lithium. While U.S. supplies of lithium are considered sufficient, the rate of increase in U.S. production would have to be accelerated to meet the expected demand. The fusion process is surveyed, and the fusion fuel requirements are examined with attention to fuel consumption by fusion reactions, fuel consumption due to blanket requirement, and blanket inventory requirements. The economics and feasibility of increasing the rate of lithium production are discussed.

M. L.

A78-49948 Design of solar heating and cooling systems for nonresidential buildings in the east north central region of the United States. R. K. Newman (Dayton, University, Dayton, Ohio). In *NAECON '78, Proceedings of the National Aerospace and Electronics Conference*, Dayton, Ohio, May 16-18, 1978. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1978, p. 862-867.

Descriptions of various solar heating and cooling projects in an area in which 60 percent of the U.S. population lives are given with emphasis on the Troy-Miami County Library system which was put in operation this past winter. Instrumentation and control strategies for the various modes of operation are discussed for this system, the Columbus Technical Institute Phase V, and the Stark County Library

buildings which will provide both solar heating and cooling. The use of solar energy to provide a large quantity of domestic hot water, swimming pool heat, and assistance to heat pumps is discussed with respect to the Deer Creek Lodge solar project. Brief descriptions of solar heating systems for a Dayton Fire Station and a Mound Laboratories building are also given.

(Author)

A78-49949 Research in the electrofluid dynamic /EFD/ wind driven generator. J. E. Minardi and M. O. Lawson (Dayton, University, Dayton, Ohio). In *NAECON '78, Proceedings of the National Aerospace and Electronics Conference*, Dayton, Ohio, May 16-18, 1978. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1978, p. 869-873. 8 refs. Contract No. EY-76-S-02-4130.

The Electrofluid Dynamic (EFD) wind driven generator directly converts wind energy to electrical energy without moving parts. Conventional wind turbines are currently limited in size, with the greatest diameter presently envisaged being 300 to 400 feet. For the EFD wind driven generator there are no fundamental reasons to restrict the size, therefore, economics of scale and far larger powers than conventional systems can be realized. Analyses predict favorable performance characteristics for EFD wind generators, however, specific experimental data have been lacking. Research areas presently being emphasized are discussed and performance of experimental arrays being conducted in an Eiffel-type wind tunnel are also discussed.

(Author)

A78-49950 A low cost aerodynamic heater representing a fully matched load for wind energy systems. M. O. Lawson (Dayton, University, Dayton, Ohio). In *NAECON '78, Proceedings of the National Aerospace and Electronics Conference*, Dayton, Ohio, May 16-18, 1978. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1978, p. 874-880.

The aerodynamic heater described operates on fluid dynamic principles as does the wind turbine. This relation makes it possible to operate the wind turbine at its optimum tip speed to wind velocity ratio up to the wind turbine rate value. The heater resembles a centrifugal blower shaped like a disk 12-inches in diameter by 4-inches thick. A sketch is provided of a heater which consists of a sheet metal case having an air intake port at the center of one circular face, and an air outlet along the perimeter. An internal rotor with blades around its circumference, an internal toroidal air passage with stator blades, and a variable outflow butterfly-valve to regulate temperature are the other components. The aerodynamic heater system may consist of a fixed-pitch wind turbine mounted on a tower along with a step-up transmission to match the torque characteristics of the wind turbine and the heater.

G. R.

A78-49961 Modeling refinements for the rectified superconducting alternator. T. A. Stuart (Toledo, University, Toledo, Ohio) and M. W. Tripp (Detroit Edison Co., Detroit, Mich.). In *NAECON '78, Proceedings of the National Aerospace and Electronics Conference*, Dayton, Ohio, May 16-18, 1978. Volume 3. New York, Institute of Electrical and Electronics Engineers, Inc., 1978, p. 1002-1009. 10 refs. Grants No. AF-AFOSR-76-2997, No. AF-AFOSR-77-3413.

Certain characteristics of an earlier steady state model developed by Stuart and Tripp (1977) for the rectified superconducting alternator are examined. The earlier approach involved the derivation of a set of five nonlinear equations, these equations were then solved via a standard Newton-Raphson algorithm, and the solution was used to evaluate several other variables. The present paper carries out an analysis which shows that the earlier model can be improved by eliminating an ambiguity associated with the ac field current and by reducing the number of system equations from five to two. Data are included to show that the modified equations are consistent with the earlier model.

B. J.

A78-50126 Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volumes 1 & 2 Congress sponsored by the Inter-American Confederation of Chemical Engineering and Asian Pacific Confederation of Chemical Engineering New York, American Institute of Chemical Engineers, 1978 Vol 1, 732 p., vol 2, 711 p. Price of two volumes, \$35

The Congress places emphasis on chemical processes of energy development and pollution control. Consideration is given to reuse and treatment of industrial waste water, utilization of cellulosic materials in unconventional food production, SO₂ stack gas scrubbing technology, environmental aspects of shale oil production and processing, advances in petroleum and petrochemical technology in the Pacific, forest residuals for the production of chemicals and energy, and filtration and magnetic separation for liquified coal and other liquids. The following topics are also examined: biochemical sources of energy, the environmental aspects of coal conversion, status and prospects of unconventional fuels, environmental aspects of tar sands processing, and the design and industrial applications of fluidized bed reactors. B J

A78-50128 Potential and economics of energy production by bioconversion E C Clausen, O C Sitton, and J L Gaddy (Missouri-Rolla, University, Rolla, Mo.) In Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 1 New York, American Institute of Chemical Engineers, 1978, p. 183-186. 16 refs

It is estimated that approximately one-fourth of the total energy requirement of the United States could be met by using present farming techniques on idle lands to produce biomass and by utilizing biomass from agricultural wastes. Conversion of biomass to methane can be accomplished through the process of anaerobic digestion. It is concluded that bioconversion of plant matter to methane is economically attractive at today's fossil fuel prices. Based on present technology, a reasonable return could be expected with a gas price of \$2/MSCF. B J

A78-50130 Flue gas desulfurization and other options F T Princiotta (U.S. Environmental Protection Agency, Washington, D.C.) In Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 1 New York, American Institute of Chemical Engineers, 1978, p. 256-260. 6 refs

Present-day options for utilizing coal to produce electricity consistent with sulfur oxide emission regulations are limited to obtaining low-sulfur coal, employing flue gas desulfurization (FGD) and in some cases physically cleaning the coal. Other emerging technologies which may be competitive with FGD in the early to mid 1980 period include fluidized bed combustion (atmospheric and pressurized), coal gasification (steam and combined cycles) and coal liquefaction. (Author)

A78-50133 Sulfur dioxide removal at Salt River Project's Coronado Generating Station G E Palomino and A G Sassi (Bechtel Power Corp., Los Angeles, Calif.) In Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 1 New York, American Institute of Chemical Engineers, 1978, p. 276-283

A78-50134 Critical analysis of sulfur dioxide removal systems for power generation applications J M Slaminski (U.S. Naval Construction Battalion Center, Civil Engineering Laboratory, Port Hueneme, Calif.) and D W Christian (Public Service Company of New Mexico, Albuquerque, N. Mex.) In Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 1 New York, American Institute of Chemical Engineers, 1978, p. 284-294. 7 refs

Seven commercial processes for extracting sulfur dioxide from steam or steam-electric generating plants are analytically compared. The operation and economics of lime and limestone slurry scrubbing, dilute and concentrated double alkali, and dilute sulfuric acid

processes with gypsum disposal products, are contrasted with sodium sulfite/bisulfite and activated char sulfur recovery systems. Each process is critically analyzed to yield system flow and operating expenses, including equipment power consumption, product disposal costs or credits, reagent requirements and operating and maintenance costs. The laws for scaling these results to any given plant capacity and coal sulfur content are developed and parametrically graphed. This information is an invaluable guide for the Navy or utility engineer to perform accurate system evaluations with ease. (Author)

A78-50135 Interface design problems between coal fired boilers and SO₂ scrubbing systems J D Ferrell and E W Stenby (Stearns-Roger, Inc., Denver, Colo.) In Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 1 New York, American Institute of Chemical Engineers, 1978, p. 295-302

For the past five to ten years, an accelerated engineering effort has been expended for the purpose of developing sulfur dioxide (SO₂) removal systems capable of treating the flue gases produced in coal-fired, steam/electric generating stations. As a result of these activities, there are now commercially available ten to twenty systems which can meet the needs of the Utility Industry. Although each of these systems is characterized by certain unique equipment designs and operating parameters, they also have in common many interfaces with the boiler system and operation. This paper presents an overview of the interactions of the boiler operation on the scrubber and vice versa. Special emphasis is placed on recent developments in applying sulfur dioxide scrubbers to large coal-fired steam generators. Where possible, the adverse operations experienced in these systems are highlighted. (Author)

A78-50136 Flue gas desulfurization in venturi scrubbers and spray towers F Bondor, J Englick, and A Saleem (Chemico Air Pollution Control Co., New York, N.Y.) In Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 1 New York, American Institute of Chemical Engineers, 1978, p. 303-307

One of the major contributors of sulfur dioxide emissions in the atmosphere today is the combustion of sulfur-bearing fossil fuels, such as those used in industrial boilers and power generating stations. These two sources account for approximately 77% of the total sulfur dioxide emissions in the United States. Enactment of sulfur dioxide emission regulations in the developed countries of the world in recent years has spurred the development of the broad range of systems for sulfur dioxide emission control. Wet scrubbing with alkali chemisorbents in water has emerged as the most widely used means of accomplishing this purpose. This paper presents a review of the commercial development of wet scrubbing processes for flue gas desulfurization in the U.S. with particular emphasis on the use of lime/limestone alkali slurries in venturi and spray tower absorbers. (Author)

A78-50137 A review of the preliminary operating results of the flue gas desulfurization unit at the Valmont Generating Station S W Goering (Public Service Company of Colorado, Denver, Colo.) and R E Nilan (Stearns-Roger, Inc., Denver, Colo.) In Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 1 New York, American Institute of Chemical Engineers, 1978, p. 316-322

A78-50141 Design of a spray tower scrubber for Coal Creek Station J R Martin (Combustion Engineering, Inc., Windsor, Conn.), R W Dutton (Black and Veatch Consulting Engineers, Kansas City, Mo.), D C Kettner (United Power Association, Elk River, Minn.), and W W Hickok (Cooperative Power Association, Minneapolis, Minn.) In Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 1 New York, American Institute of Chemical Engineers, 1978, p. 389-394

Coal Creek Station is a two-unit 1000-MW generating plant being constructed in N. Dakota. The present paper describes the

design and operational features of the spray tower scrubber system designed to control sulfur dioxide emissions from the power plant, which burns low-sulfur lignite. Plant design considerations which influence the cleaning and dispersal of combustion gases are presented. Some of the features of the scrubber system designed to meet the requirements imposed by the plant design are high-efficiency spray tower absorbers, use of alkali in fly ash, and scale control. B J

A78-50142 Factors that influence the leaching of organic material from in situ spent shale. G. Amy and J. Thomas (California, University, Berkeley, Calif.) In *Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 1*. New York, American Institute of Chemical Engineers, 1978, p. 398-402. Research sponsored by the U.S. Department of the Interior and ERDA.

A series of batch and continuous flow experiments were run in order to assess the potential for contamination of groundwater by organic material leached from in situ spent shale. The specific objectives of these experiments were to (1) estimate the concentration of organic material present in leachate derived from various types of in situ spent shale, and (2) identify variables that affect the concentration of organic material in leachate. Concentrations of total organic carbon (TOC) as high as 50 milligrams per liter were detected during experimentation. Factors that significantly influenced the concentration of organic material present in leachate included (1) retorting conditions associated with spent shale, (2) spent shale particle size, (3) water temperature, and (4) leaching time. (Author)

A78-50143 Sorption of SO₂ on spent shale in packed beds. M. A. Hasanain, A. L. Hines, C. L. Murphy (Colorado School of Mines, Golden, Colo.), and J. J. Duvall (U.S. Department of Energy, Laramie Energy Research Center, Laramie, Wyo.) In *Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 1*. New York, American Institute of Chemical Engineers, 1978, p. 416-421. 6 refs. Contract No. E(29-2)-3780.

Adsorption studies of SO₂ have been carried out on spent shale that was retorted at temperatures ranging from 300 to 1000 deg C. A chemical analysis and an X-ray diffraction analysis of all retorted samples were made. In addition, breakthrough curves of SO₂ on spent shale are presented along with the calculated isotherm. (Author)

A78-50144 Should anaerobic digestion - for methane gas recovery - be included in a sludge treatment process utilizing incineration? L. Hamer (Passavant Corp., Birmingham, Ala.) In *Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 1*. New York, American Institute of Chemical Engineers, 1978, p. 698-702.

The paper examines the economic feasibility of using anaerobic digestion and incineration in the treatment of a municipal primary/waste-activated sludge stream. It is shown that the process which utilizes anaerobic digestion and incineration has a cost per ton of treated sludge considerably greater than either of those which do not employ digestion. Moreover, the sludge conditioning cost-reduction realized by using the incinerator ash as an admix agent sufficiently offsets other somewhat greater expenses. B J

A78-50145 Technical and economical feasibility of biomass utilization as energy source in California. V. Cervinka (California State, Dept. of Food and Agriculture, Sacramento, Calif.) In *Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 2*. New York, American Institute of Chemical Engineers, 1978, p. 752-758. 11 refs.

The potential overall biomass resource of California, including crop residues, dairy and feedlot waste, food processing industry waste, and municipal solid waste, is estimated to be 1.570×10 to the 7th dry tons per year. The heat content value of this resource is 1.11648×10 to the 10th J/ton, the gasification efficiency is 62, the energy equivalent value of gas generated is 1.0861×10 to the 17th

J/year. To make California agriculture self-supporting, the remaining 55% of total energy required for food production can be potentially generated from crops grown as renewable energy resources. B J

A78-50146 Biochemical routes to energy recovery from municipal wastes. A. J. Klee and C. J. Rogers (U.S. Environmental Protection Agency, Municipal Environmental Research Laboratory, Cincinnati, Ohio.) In *Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 2*. New York, American Institute of Chemical Engineers, 1978, p. 759-764. 15 refs.

After analyzing the weaknesses of the conventional process to produce methane from the anaerobic digestion of municipal solid wastes, three pretreatment approaches are described and compared: alkali pretreatment, enzymatic hydrolysis, and acid hydrolysis. The major findings are that alkali pretreatment is effective and holds promise particularly for small-scale operations, and that recent advances in acid hydrolysis make it a significant and economically attractive technology for energy, chemical, and food production. (Author)

A78-50147 Survey of pyroconversion processes for biomass. T. B. Reed (Synthetic Fuel Research Center, Concord, Mass.) In *Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 2*. New York, American Institute of Chemical Engineers, 1978, p. 765-768. 12 refs.

The chemistry, thermodynamics, and process steps of the pyroconversion of biomass are described. Consideration is given to chemical reactions of biomass, char reactions and charcoal production, pyrolytic oil production, and gasification, hydrogenation, and combustion of biomass. The biomass can be burned directly for heat, or it can be converted to solid, liquid or gaseous synthetic fuels. B J

A78-50148 Multi-stage digestion to fuel gas of municipal solid waste. D. L. Wise, R. L. Wentworth, D. C. Augenstein (Dynatech R/D Co., Cambridge, Mass.), and C. L. Cooney (MIT, Cambridge, Mass.) In *Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 2*. New York, American Institute of Chemical Engineers, 1978, p. 769-776. 14 refs. Research supported by the Consolidated Natural Gas Service Co.

Multistage digestion experiments on shredded municipal solid waste were carried out with the aim of developing improved practical processing systems for solid waste. The multistage digestion process is primarily one of separating two broad groups of microorganisms, namely, the acid formers which solubilize cellulosic materials to organic acids, and the methane formers which convert the solubilized materials to fuel gas. The acid forming step was accomplished using a plug flow digester system of up to 10 individual reactors in series. When solubilized breakdown products were used as feed material to the second stage or methane forming reactor, conversion to fuel gas at high methane content was achieved. B J

A78-50149 Environmental factors for Fischer-Tropsch coal conversion technology. J. B. O'Hara, B. I. Loran, A. Bela, and N. E. Jentz (Ralph M. Parsons Co., Pasadena, Calif.) In *Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 2*. New York, American Institute of Chemical Engineers, 1978, p. 855-863. 8 refs. ERDA-supported research.

The environmental factors of a conceptual commercial Fischer-Tropsch coal conversion plant are discussed. The Fischer-Tropsch process, which converts coal into gaseous and liquid hydrocarbons, is briefly reviewed. The removal of sulfur and particulates from the syngas generated, the sulfur balance of the conversion process, and the quantity and types of effluent streams projected to be released are described. Estimated air emissions and aqueous effluents are compared with applicable standards and found capable of meeting the present and projected regulations. The fate of trace elements present in the coal and occupational safety aspects are also briefly considered. (Author)

A78-50150 Conversion of western U.S. coals to liquid products. R. H. Wolk, H. E. Lebowitz, W. C. Rovesti, and N. C. Stewart (Electric Power Research Institute, Palo Alto, Calif.) In Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 2 New York, American Institute of Chemical Engineers, 1978, p. 900-907. 15 refs.

Information is reviewed on yields and operating conditions based on Wyodak, Amox, Kaiparowitz, and Black Mesa subbituminous coals. These are compared with results from eastern coals. Recent information on early reaction chemistry for Wyodak coal is also presented and compared to similar results with bituminous coal. The formation of calcium-rich solids has been noted in several of the test programs. Several speculative flowsheets are presented which combine hydrogenation, residue gasification, and solids separations in new ways with the aim of lowering liquid product cost. B. J.

A78-50151 The SRC-II process. B. K. Schmid and D. M. Jackson (Gulf Mineral Resources Co., Denver, Colo.) In Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 2 New York, American Institute of Chemical Engineers, 1978, p. 908-915. 5 refs.

SRC-II is an improved version of the Solvent Refined Coal process. The primary product of this advanced process is an ashless distillate fuel containing less than 0.4% sulfur, in contrast to the solid fuel produced in the original version of the process. Additional products of SRC-II are pipeline gas, LPG, a light distillate liquid, phenols, and ammonia. With the completion of pilot scale development work, the SRC-II process will be ready for commercial-scale demonstration. A demonstration program is proposed using full-scale equipment in a single process module plant which could eventually be incorporated in a commercial facility. B. J.

A78-50152 Recovery and utilization of extreme low temperature geothermal energy in Korea. H. D. Yoo (Korea Advanced Institute of Science, Seoul, South Korea) In Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 2 New York, American Institute of Chemical Engineers, 1978, p. 923-929. 14 refs. Research supported by the Korea Advanced Institute of Science.

The recovery of low temperature geothermal energy (40-80°C) in Korea is investigated by injecting air seasonally for local community heating without heat exchangers, when a gas storage development is planned. A preliminary design was conducted to study the feasibility of the scheme. Safety, economics, reserve estimation, and aquifer dynamics were studied. Other recovery methods and power generation have been briefly reviewed. Conversion to a small gas storage system upon depletion of geothermal energy, because of Korea's pressing need for underground storage system and the overall economic advantage, plays a very significant role to make the energy recovery attractive. (Author)

A78-50153 Impact of solar heating and cooling on electric utilities. R. Llavin, Jr. and J. A. Bonnet, Jr. (Puerto Rico Water Resources Authority, San Juan, P.R.) In Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 2 New York, American Institute of Chemical Engineers, 1978, p. 1068-1075.

The impact of solar heating and cooling on an electric utility was assessed in terms of the effect of this load on the generating system, transmission system, and corporate financial structure during the next ten years. Heating and cooling loads were defined in terms of their number, their energy consumption, and their load pattern. Estimates of these loads were validated through load survey measurements on a selected statistical sample of customers. The effect of solar heating and cooling on the utility was found to be relatively minor although a revision of the existing rate structure will probably be required within three or four years. (Author)

A78-50154 Evaluation of a commercial-scale hydrocarbonization process to produce clean char, oil, and pipeline gas from coal. J. M. Holmes, D. A. Dyslin, M. S. Edwards, D. S. Joy, G. R. Peterson, C. B. Smith, and P. M. Lantz (Oak Ridge National Laboratory, Oak Ridge, Tenn.) In Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 2 New York, American Institute of Chemical Engineers, 1978, p. 1081-1087. 17 refs. ERDA-sponsored research.

This preliminary design and an economic evaluation of a hydrocarbonization facility include: (1) beneficiation of the coal feed, (2) coal hydrocarbonization to produce char, oil, and pipeline gas fuels, (3) fluid-bed combustion for steam and power generation, (4) liquid product hydrotreating, and (5) treatment of all plant effluents. A discounted cash flow analysis assuming 100% equity financing, 12% return on equity, and coal priced at \$20/ton resulted in a product fuel price of \$3.15/million Btu. An alternative system, in which the char is utilized as fuel for a power plant and a coal mine is included, demonstrated that for a power cost of 30 mills/kWhr and a gas price of \$3.50/MSCF, the oil price would be \$12.50/bbl using utility financing. (Author)

A78-50155 The Pacific area energy supply/demand outlook - The next fifteen years versus now. J. A. West (Federal Energy Administration, Washington, D.C.) In Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 2 New York, American Institute of Chemical Engineers, 1978, p. 1092-1097.

The Pacific region's current and evolving energy situation is evaluated and assessed in terms of its associated economic and political implications. The Pacific area is expected to continue as an energy deficit area through 1990. Total primary energy requirements (TPE) are forecast to grow at about 6 percent per annum and reach 26.6 million barrels per day of oil equivalent in 1990. Oil, largely from other sources, will remain the primary fuel consumed in the area and account for nearly two-thirds of projected TPE. As in the past, Japan will remain the largest energy user and account for over two-thirds of the region's forecasted 1990 crude oil imports of 14 million barrels per day and about 57 percent of the region's forecasted TPE. Higher world energy prices will dampen demand and stimulate the development of alternative energy sources in the area. Steam coal and nuclear energy offer good supply prospects in the post-1985 period. (Author)

A78-50157 Application of best practicable technology in air pollution control for the Syncrude project. R. R. Goforth (Syncrude Canada, Ltd., Edmonton, Alberta, Canada) In Pacific Chemical Engineering Congress, 2nd, Denver, Colo., August 28-31, 1977, Proceedings Volume 2 New York, American Institute of Chemical Engineers, 1978, p. 1287-1294. 9 refs.

The Syncrude project in northeastern Alberta, requiring the mining of 83,000,000 tonnes of tar sand feed per year, is designed to produce 125,000 barrels a day of synthetic crude. The air pollution control facilities in the Syncrude project are reviewed in terms of 'best practicable technology' criteria, which involve three basic requirements: (1) environmental need, (2) demonstrated technological and economic feasibility, and (3) acceptable overall project economics including consideration of energy and environmental costs. B. J.

A78-50221 * # Attitude control of large solar power satellites. R. E. Ogilvie (Rockwell International Corp., Downey, Calif.) In Guidance and Control Conference, Palo Alto, Calif., August 7-9, 1978, Technical Papers New York, American Institute of Aeronautics and Astronautics, Inc., 1978, p. 571-578. 14 refs. Research supported by the Rockwell International Corp., Contract No. NAS8-32475 (AIAA 78-1266).

Satellite power systems are a promising future source of electrical energy. However, the very large size solar power satellites (relative to contemporary spacecraft) requires investigation of the resulting attitude control problems and of appropriate control techniques. The principal effects of the large size are a great increase

in sensitivity to gravity-gradient torques and a great reduction in structural bending frequencies with the attendant likelihood of undesirable control system interaction. A wide variety of control techniques are investigated to define approaches that minimize implementation penalties. These techniques include space-constructed momentum wheels, gravity-gradient stabilization, quasi-inertial free-drift modes, and various reaction control thruster types, some of which reduce the implementation penalties to a few percent of the spacecraft mass. The control system/structural dynamic interaction problem is found to have a tractable solution. Some of the results can be applied to other large space structure spacecraft.

(Author)

A78-50251 Chances for exotics - Regenerable energy sources (Chance für Exoten - Regenerierbare Energiequellen). U. Kaier (Kraftanlagen AG, Heidelberg, West Germany) *Energie*, vol 30, July 1978, p 219-223. In German.

Characteristics of several forms of regenerable energy - moving water, earth heat, solar radiation, biochemical processes, and wind - are briefly surveyed. Other topics include energy storage and the generation of electricity from sunlight. Costs and prospects of development are considered in some cases. M. L.

A78-50252 Oil shale - Power source and raw material (Ölschiefer - Energieträger und Rohstoff). *Energie*, vol 30, July 1978, p 224-227. In German.

The 'Rohrback' direct combustion procedure for obtaining both energy and a raw material for cement manufacture from oil shale is described. Combustion occurs rapidly in a fluidized bed oven kept at 800-850 C. Pulverization, preheating, role of the waste-heat boiler, and treatment of the clinker are described, and the economics of the process is examined. M. L.

A78-50253 Cold energy (Die 'kalte' Energie). D. Weber (Gutehoffnungshütte Sterkrade AG, Oberhausen, West Germany) *Energie*, vol 30, July 1978, p 238-241. In German.

A procedure for obtaining low-cost electricity by using evaporated LNG to drive gas turbines in a closed process is proposed. The gas turbine in conjunction with a diesel motor would be located at an LNG terminal and is thought to be capable of providing 211 MW at an efficiency of 60%. The components and the circulation scheme of the proposed gas turbine are considered, and characteristics of existing gas turbines, LNG terminals, LNG evaporation, and cost estimates are explained. M. L.

A78-50254 Pyrolysis Flameless competition - Gasification of trash for the recovery of material (Pyrolyse Konkurrenz ohne Flamme - Die Vergasung von Abfällen zur Gewinnung von Energie). F. Nowak *Energie*, vol 30, July 1978, p 243-247. In German.

Pyrolytic procedures for obtaining energy from garbage are discussed. The procedures might be able to provide a higher energy yield more economically than is obtained from the burning of garbage. Attention is directed to the Kiener system which utilizes a low-temperature procedure for gasification of the organic material from garbage. The pyrolysis of household garbage by the Kiener system is considered with attention to the material balance and energy balance of the process. M. L.

A78-50300 Back-reflection effect on the long-wavelength spectral response of solar cells. L. A. Hussain (Ibadan, University, Ibadan, Nigeria) *Journal of Physics D - Applied Physics*, vol 11, Aug 1, 1978, p 1535-1537.

In the present paper, the effect of back reflection on the long-wave spectral response of solar cells is calculated on the basis of a simple n-on-p solar cell model. The effect is found to depend primarily on the cell thickness and to be sufficiently strong to justify consideration in solar cell design and manufacture and in the analysis of spectral response data. V. P.

A78-50401 Solar cell materials and their basic parameters. E. Bucher (Konstanz, Universität, Konstanz, West Germany). *Applied Physics*, vol 17, Sept 1978, p 1-26. 286 refs. Bundesministerium für Forschung und Technologie Contract No. ET-4007-A, Deutsche Forschungsgemeinschaft Contract No. BU-362/1.

An extensive survey of solar cell materials and their basic parameters is presented. Various types of cells (homojunctions with elements, heterojunctions with elements, MIS and Schottky diodes with elements) are classified according to cell structure, crystalline state, gaps, open-circuit voltage, illumination condition, and the constitution and thickness of antireflect layers. Developments in the silicon area, III-V compounds, II-VI compounds, binary compounds, chalcopyrites II-IV-V₂ and I-III-VI₂, and organic semiconductors are discussed. An extensive bibliography is included. S. C. S.

A78-50423 Fossil fuel - Future shock. J. Gribbin (Sussex, University, Brighton, England) *New Scientist*, vol 79, Aug 24, 1978, p 541-543.

The effect of an increased amount of atmospheric CO₂ on the climate is discussed. The role of natural reservoirs of CO₂ is examined with attention to the question of whether the reservoirs still retain unlimited capacity or are nearing the end of their capacity. It is suggested that the oceans, which now contain more than ten times as much carbon as the biomass and atmosphere together, might serve for longterm and massive storage of CO₂. The 'quality of life' likely to result if CO₂-induced temperature increases and changes in water/rain patterns occur is weighed, and it is suggested that the changes should not a priori be judged undesirable. Limitation of model predictions and possible model accuracies are considered. M. L.

A78-50425 Sweden strides towards a solar society. G. Taylor *New Scientist*, vol 79, Aug 24, 1978, p 550-552.

The Swedish program for developing solar energy sources is described and contrasted with the British approach to energy research. The Swedish program envisions a 37% larger supply of energy in 2015 than was available in 1975, about 12% of the increased energy would come from direct solar heating, 62% would come from biomass-yielding solid, liquid, and gaseous fuels, and approximately 26% would come from solar-generated electricity, including hydroelectricity. It is suggested that, in contrast with the British approach, the Swedes have placed more emphasis on simply applied conservation practices, are less interested in expensive research programs, and have funded a more diverse group of researchers. The program for developing residential passive solar heating in Sweden is described. M. L.

A78-50568 # Combustor performance of high availability fuels. C. A. Moses and D. W. Naegeli (US Army, Fuels and Lubricants Research Laboratory, San Antonio, Tex.) *Combustion Institute, Spring Technical Meeting, West Lafayette, Ind., Apr 3, 4, 1978, Paper 10 p*.

In connection with shortages which might occur with respect to currently used jet fuels, investigations have been conducted regarding the feasibility to employ other fuels, which are available in adequate quantities. The reported study is concerned with the effect which the substitution of such fuels will have on combustor performance. A 2-inch diameter cylindrical research combustor designed for high temperatures and pressures was used in the study. It was found, however, very difficult to draw significant conclusions about the effects of fuel properties on combustion efficiency. This difficulty was related to the geometry of the combustor which was such that if the flame could be stabilized in the primary zone, combustion was very efficient. Even the two fuels with the highest end points and viscosities were not significantly different. G. R.

A78-50569 # Variability of emissions measurements on a small gas turbine engine. G. Opdyke, Jr. (Avco Corp., Avco Lycoming Stratford Div., Stratford, Conn.) *Combustion Institute, Spring Technical Meeting, West Lafayette, Ind., Apr 3, 4, 1978, Paper 15 p*.

A turboprop engine, rated at 620 equivalent shaft horsepower at takeoff, configured with a shaft engine gearbox for test convenience, was tested twenty times in a one-month period for measurement of emission levels. Ten different fuel manifold and injector assemblies were tested. The obtained results show that changing fuel injectors will have an impact on emission levels. The variability which results is larger than that caused by injector design differences or by the differences in the physical characteristics between Jet A and DF-2 fuels. The fuel injector effect could not be explained by the variation of fuel flow between individual injectors. It is concluded that the fuel spray droplet spatial distribution, probably unique to each single injector, is such that hydrocarbon emissions are significantly affected by fuel droplet or vapor impingement in the wall cooling film, and CO emissions vary because of reaction quenching in the mainstream and in the cooling film. G R

A78-50571 # Alternative fuel effects upon combustion efficiency in continuous combustors D A Schmidt and A M Mellor (Purdue University, West Lafayette, Ind.) *Combustion Institute, Spring Technical Meeting, West Lafayette, Ind., Apr 3, 4, 1978, Paper 8 p 5 refs* Army-supported research

The ability of the gas turbine engine to burn a variety of fuels is an important asset in connection with considerations which take into account the undesirability of a dependency on foreign crude oil. A gas turbine engine will, therefore, power the next generation Army main battle tank. Effects related to the use of different fuels are to be investigated. A systematic study is in this connection conducted of fuel volatility and viscosity relationships with efficiency. It is found that an increase in combustion inefficiency with heavier fuels is due to the larger droplets in the spray penetrating through the shear layer into the relatively cooler free stream air where CO and HC oxidation reactions are quenched. Results to date show that Jet A blended exhibits slightly higher combustion inefficiency than no. 2 diesel fuel. The 90% distillation point appears to be the important distillation regime relevant to combustion inefficiency. G R

A78-50587 The development of a regenerator seal for vehicular use M Kitano, H Okano (Toyota Motor Co., Ltd., Shizuoka, Japan), T Otani (Hino Motors, Ltd., Hino, Tokyo, Japan), and Y Kondo (Nippon Denso Co., Ltd., Kariya, Aichi, Japan). In Tokyo Joint Gas Turbine Congress, Tokyo, Japan, May 22-27, 1977, Proceedings Tokyo, Gas Turbine Society of Japan, 1977, p 97-103, Discussion, p 104. 5 refs

The development of a regenerator seal for the GT-21 two-shaft regenerative gas turbine engine for the Hino RL bus is described. It was very important for seal durability that the mean contact pressure of the seal against the core should be small and that local contact pressure should not be excessive. Candidate materials were surveyed and graphite was found to be the most suitable for a cold side seal and for the peripheral part of the hot side seal. A modified seal, whose peripheral part was made of graphite and a thin metal plate, showed good performance and seemed to have good durability. B J

A78-50588 Aluminous keatrite - A durable ceramic material for rotary regenerator cores D G Grossman and J G Lanning (Corning Glass Works, Corning, N.Y.) In Tokyo Joint Gas Turbine Congress, Tokyo, Japan, May 22-27, 1977, Proceedings Tokyo, Gas Turbine Society of Japan, 1977, p 105-110 7 refs

Operating characteristics of rotary ceramic regenerator cores in small gas turbines are discussed. Included in the discussion are material, configurations and structural considerations. Core performance in several different engine designs is described. (Author)

A78-50592 A study on a premixed combustor for a vehicular gas turbine T Morishita (Toyota Motor Co., Ltd., Susono, Shizuoka, Japan), K Nakamura (Toyota Motor Co., Ltd., Toyota, Aichi, Japan), and Y Tanasawa (Toyota Central Research and Development Laboratories, Inc., Nagoya, Japan). In Tokyo Joint

Gas Turbine Congress, Tokyo, Japan, May 22-27, 1977, Proceedings Tokyo, Gas Turbine Society of Japan, 1977, p 137-141, Discussion, p 142 6 refs

A study on premixed combustion and its characteristics are presented. Its marginal air temperature and pressure at its flash back limits are quite high up to 700 C and 5 ata which are the conditions required to the premixed combustor as a component of a regenerative gas turbine engine with low pressure ratio. And also, combustion characteristics of a premixed annular combustor developed on this concept of the premixed combustion are presented as well. (Author)

A78-50601 Development of the experimental gas turbine bus S Yamazaki and T Itoh (Nissan Motor Co., Ltd., Central Engineering Laboratories, Yokosuka, Japan). In Tokyo Joint Gas Turbine Congress, Tokyo, Japan, May 22-27, 1977, Proceedings Tokyo, Gas Turbine Society of Japan, 1977, p 223-229, Discussion, p 230

Nissan Motor Company has designed and built the experimental gas turbine buses to evaluate the performance of vehicles equipped with gas turbines. The purposes of developing a gas turbine bus are to purify exhaust gas emissions, eliminate smoke and odor, reduce driving noise, and ultimately to manufacture a bus that permits greater riding comfort, with less pollution and less vibration. This paper describes the construction, performance, noise reduction and emission control of the Nissan Gas Turbine Bus. (Author)

A78-50602 Advantages of 3-shaft KTT gas turbine configurations for automotive applications S O Kronogard (United Turbine AB and Co., Malmo, Sweden). In Tokyo Joint Gas Turbine Congress, Tokyo, Japan, May 22-27, 1977, Proceedings Tokyo, Gas Turbine Society of Japan, 1977, p 231-238, Discussion, p 238-240 6 refs

This paper gives a brief description of an experimental version of the KTT turbine system, its components and their relative arrangement as well as some of the basic thinking behind this new concept. The paper also gives a short description of the possibilities with this system to introduce ceramics at an early stage. It also describes a new way of obtaining fast acceleration, low idling speed and low part load fuel consumption. (Author)

A78-50603 A development of advanced radial gas turbine for automobile S Sasaki, K Takizawa (Toyota Motor Co., Ltd., Susono, Shizuoka, Japan), and N Mizumachi (Tokyo, University, Tokyo, Japan). In Tokyo Joint Gas Turbine Congress, Tokyo, Japan, May 22-27, 1977, Proceedings Tokyo, Gas Turbine Society of Japan, 1977, p 241-247, Discussion, p 247, 248 5 refs

A performance estimation of a radial inflow turbine based commonly on the assumption in which the flow at rotor-exit was one-dimensional having no rotor-exit swirl. Through the investigation of the test results obtained from the turbine designed with this design procedure, it was found to be expectable to have some improvements by having an alternative design approach. The new design procedure would be described as follows. The flow at rotor-exit was analyzed two-dimensionally in which the loss distribution from the rotor hub to tip was assumed to be a function of rotor-exit radius. The optimum rotor-exit swirl corresponding to the maximum efficiency was obtained by estimating performances for various intensities of swirl. The efficiency of the turbine designed with the improved design procedure indicated the improvement by about 7 percent compared to the case of the turbine designed by using the conventional procedure. (Author)

A78-50604 Energy economy with high temperature gas-turbine H G Munzberg (Munich, Technische Universität, Munich, West Germany). In Tokyo Joint Gas Turbine Congress, Tokyo, Japan, May 22-27, 1977, Proceedings Tokyo, Gas Turbine Society of Japan, 1977, p 249-258, Discussion, p 259 5 refs

Techniques for cooling high-temperature gas turbines are considered, and a comparison of air cooling and liquid-metal cooling of gas turbines with hollow blades shows the superior advantages of the

latter technique. An optimization study for the liquid-metal cooling is reported, and the utilization of the liquid-metal heat and of the exhaust heat is considered. Gas turbines with good fuel consumption characteristics are compared with gas turbines with optimized construction features. M L

A78-50612 A research on centrifugal compressor for small gas turbine - The effect of recirculating flow S Higuchi (Toyota Motor Co., Ltd., Susono, Shizuoka, Japan) and K Nakamura (Toyota Motor Co., Ltd., Toyota, Aichi, Japan) In Tokyo Joint Gas Turbine Congress, Tokyo, Japan, May 22-27, 1977, Proceedings Tokyo, Gas Turbine Society of Japan, 1977, p 337-342, Discussion, p 342, 343

The recirculating flow in centrifugal compressor was investigated on its effects to the performance through both the empirical and theoretical studies. The effects on compressor performance were investigated here by considering it for impeller and diffuser separately. This study indicated that the compressor stage characteristics were continuously deteriorated as the recirculating flow rate increased, which would adversely affect on the performance of a gas turbine engine especially when the engine size is small. Since the recirculating flow effects tend to increase as mass flow rate reduces. This study also indicated that the effects were predictable by considering both the pressure drop at diffuser inlet and the resulting mismatching of diffuser inlet angle due to the recirculating flow. It was suggested that the degree of the deterioration due to the recirculating flow would be minimized by guiding the recirculating flow towards radial direction at rotor tip. (Author)

A78-50632 Development of ceramic components for an automotive gas turbine P Walzer (Volkswagenwerk AG, Wolfsburg, West Germany) and S Forster (Kernforschungsanlage Julich GmbH, Julich, West Germany) In Tokyo Joint Gas Turbine Congress, Tokyo, Japan, May 22-27, 1977, Proceedings Tokyo, Gas Turbine Society of Japan, 1977, p 550-557, Discussion, p 557, 558 14 refs. Research sponsored by the Bundesministerium fur Forschung und Technologie

The article surveys the development of components made from high-temperature ceramics for applications in automotive gas turbines. Requirements for ceramic turbine components are identified for both steady-state and unsteady operation. Various high-temperature ceramics are described including Si₃N₄ (hot pressed, reaction sintered), SiC (hot pressed, reaction bonded, Si-infiltrated), and glass ceramics. Current research on the development of ceramic combustion chambers, turbine rotors, and rotors with metallic hubs and ceramic blades is reviewed. S C S

A78-50850 Alternative fuel methanol - Selection criteria and status of research (Alternativkraftstoff Methanol - Auswahlkriterien und Stand der Forschung). A Konig, H Menrad, W Lee, and W Bernhardt (Volkswagenwerk AG, Wolfsburg, West Germany) *Erdol und Kohle Erdgas Petrochemie vereinigt mit Brennstoff-Chemie*, vol. 31, Aug 1978, p 360-367 17 refs. In German. Research supported by the Bundesministerium fur Forschung und Technologie

A description is presented of the results of an investigation in which the possibilities and problems with respect to a use of methanol as alternative fuel for motor vehicles have been studied. It is pointed out that of all available fuel alternatives methanol appears to be most suited for a possible replacement of currently used fuels. Prototypes of vehicles for the use of methanol in undiluted form are being developed and optimized. The use of a 15% methanol-gasoline mixture as an intermediate step with respect to the introduction of methanol was investigated in a fleet test. Economic factors are of primary importance concerning the time of an introduction of methanol as fuel. On the basis of long-term considerations, a comparison of the costs involved in producing methanol and conventional fuels from coal appears vital. Such a comparison is in favor of methanol. G R

A78-50900 Photo-voltaic properties of metal-oxide-CdS solar cells. K P Pande (Rensselaer Polytechnic Institute, Troy, N.Y.) and B Singh (National Physical Laboratory of India, New Delhi, India) *Institution of Electronics and Telecommunication Engineers, Journal*, vol. 24, June 1978, p 253-256 12 refs

MIS solar cells based on metal-oxide-CdS structures have been fabricated and their photovoltaic properties have been evaluated. For a typical cell, maximum open-circuit voltage and short-circuit current have been obtained as 0.55 V and about 1 mA/sq cm at an illumination intensity of 120 mW/sq cm. Dark current in the cells has been found to be mainly dominated by tunnelling via interface states. A high density of states seems to exist in the interface between oxide and CdS which is estimated as approximately 10 to the 12th power/sq cm/eV. (Author)

A78-51062 Solar cells - Plugging into the sun J C C Fan (MIT, Lexington, Mass.) *Technology Review*, vol. 80, Aug-Sept 1978, p 14, 15, 20, 22-36 60 refs. Research supported by the U S Department of Energy and U S Air Force

An elementary discussion of the principles of solar cells is given. Factors affecting solar cell efficiency are discussed. The concept of splitting the solar spectrum into different ranges for which different cells operate most efficiently is described. The tandem cell system and filter-reflector system for achieving the splitting are illustrated. The principle types of cell structures are described, and the needed cost reductions in materials and technologies for silicon solar cells to meet D O E. goals are discussed. P T H

A78-51063 Used oil - Collection, recycling and disposal W A Irwin (U S Department of the Interior, Washington, D C) *Technology Review*, vol. 80, Aug-Sept 1978, p 54-61

Some of the basic processes by which used oil is re-refined are briefly reviewed, and the status of the laws and statutes of the U S federal government and state governments touching on the question of oil reuse and/or safe disposal of used oil are examined. It is pointed out that the government through tax rulings and consumer protection regulations has placed the used oil recycling industry at a competitive disadvantage with the virgin oil industry. The D O E's involvement with used oil recycling efforts is outlined. A model bill requires a government agency to issue rules which prescribe means for the provision of safe and conveniently located collection facilities for used oil. Recyclers or disposers would be licensed and would be required to submit reports to the agency. A summary of oil recycling policies in several European countries is given. P T H

A78-51064 Can we save energy by taxing it J F Boshier *Technology Review*, vol. 80, Aug-Sept 1978, p 62-66, 70, 71

The present paper discusses the political and economic issues raised by the two principal components of the current National Energy Plan - investment tax credit and taxes on energy sources. It is argued that taxation to increase the price of energy will enable the economic and social effects of higher energy prices to be monitored and managed. Taxes can be used to stimulate necessary new technologies. On the other hand, the conservation tax credit is working against a long-term U S policy of taxation which encourages investment in energy-intensive equipment to substitute for labor. P T H

A78-51066 Use of carbon dioxide in energy storage R Williams, R S Crandall, and A Bloom (RCA Laboratories, Princeton, N.J.) *Applied Physics Letters*, vol. 33, Sept 1, 1978, p 381-383 14 refs

A method for hydrogen storage is described which involves electrochemical reduction of CO₂ in water to produce organic compounds. The relevant reaction sequence for electrochemical reduction of CO₂ to formic acid is outlined. It is noted that the formic acid so produced is easily stored as a stable product and can be either converted to hydrogen by means of a catalyst or used directly as a fuel. The energy storage density achieved by this method is shown to be high. Experiments are discussed which

indicate that hydrogen could be produced at pressures of the order of 1000 atm by catalytic conversion of formic acid to hydrogen and CO₂ and that the energy efficiency for the proposed process can be as high as 60% F G M

A78-51067 * **A cesium plasma TELEC device for conversion of laser radiation to electric power** E J Britt, N S Rasor (Rasor Associates, Inc., Sunnyvale, Calif.), G Lee, and K W Billman (NASA, Ames Research Center, Moffett Field, Calif.) *Applied Physics Letters*, vol 33, Sept 1, 1978, p 384-386 11 refs Contract No NAS2-9109

Tests of the thermoelectronic laser energy converter (TELEC) concept are reported. This device has been devised as a means to convert high-average-power laser radiation into electrical energy, a crucial element in any space laser power transmission scheme using the available high-power/efficiency infrared lasers. Theoretical calculations, based upon inverse bremsstrahlung absorption in a cesium plasma, indicate internal conversion efficiency up to 50% with an overall system efficiency of 42%. The experiments reported were made with a test cell designed to confirm the theoretical model rather than demonstrate efficiency. 10.6-micron laser-beam absorption was limited to about 0.001 of the incident beam by the short absorption region. Nevertheless, confirmatory results were obtained, and the conversion of absorbed radiation to electric power is estimated to be near 10% (Author)

A78-51068 * **A Schottky-barrier solar cell on sliced polycrystalline GaAs** Y C M Yeh and R J Stirn (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) *Applied Physics Letters*, vol 33, Sept 1, 1978, p 401-403 6 refs

Antireflecting-metal-oxide-semiconductor (AMOS) technology has been applied to sliced wafers of polycrystalline GaAs having grain sizes of about 100 microns. Simulated AM1 sunlight efficiencies up to 14% were obtained, and studies using the scanning electron microscope showed that grain boundaries have a minimal effect on short-circuit current density. However, current-voltage characteristics show some influence on open-circuit voltage (Author)

A78-51070 **Open-circuit voltage of vertical-junction photovoltaic devices at high intensity** T W Ekstedt, J E Mahan, R I Frank, and R Kaplow (MIT, Cambridge, Mass.) *Applied Physics Letters*, vol 33, Sept 1, 1978, p 422, 423 9 refs. Research supported by the National Patent Development Corp.

Vertical single-junction silicon photovoltaic cells show a steady increase in open-circuit voltage with increasing incident light intensity of approximately 0.1 V per decade of intensity, up to approximately 100 W/sq cm (about 1000 suns). Voltages as high as 0.76 V have been observed at 25 C with no apparent saturation of voltage at high intensity. Measurements are presented for cells of various base doping levels. An efficiency of 19.1% has been observed at 76 W/sq cm and 25 C using an unfiltered xenon short-arc lamp for a nonoptimized cell (Author)

A78-51220 **A technical, economic and environmental assessment of utilizing solar energy for heating/cooling and energy conversion** R Romancheck (Research and Technical Services, Allentown, Pa.) *Energy Communications*, vol 4, no 5, 1978, p 433-439

The desirability of employing solar energy for heating is examined with attention to the availability of sunshine in different regions of the U.S. A solar collection cost breakdown is presented, and it is concluded that government subsidy will be required if collector panels are to be sold cheaply. Electrical energy conversion and solar cooling are not thought to be economically feasible for extensive use. Procedures for increasing the cost effectiveness of solar equipment are surveyed M L

A78-51221 **Implications of utilizing synthetic fuels in combined cycles** D J Ahner (General Electric Co., Schenectady, N Y.) *Energy Communications*, vol 4, no 5, 1978, p 441-468

Ash-forming trace contaminants, chemical properties, and physical properties of synthetic fuels derived from coal are discussed with reference to the design of gas turbines and related equipment. It is noted that most turbines have been designed for use with fuel oil, and a change in fuel characteristics would probably require modification of materials selection, thermodynamic cycle, and operating conditions as well as design conversion. Combined cycle performance and synthetic fuel requirements are summarized, and the effects of synthetic fuel combustion on air pollution are considered M L

A78-51243 **Electronic characterization of indium tin oxide/silicon photodiodes** N S Chang and J R Sites (Colorado State University, Fort Collins, Colo.) *Journal of Applied Physics*, vol 49, Sept 1978, p 4833-4837 18 refs Contract No E(04-3)-1203

The electronic characteristics of photodiodes of indium tin oxide deposited on single-crystal p-silicon are reported. Where possible, comparisons are made with measurements of a standard NASA p-n-junction solar cell. Dark measurements include the current and capacitance dependences on voltage and temperature. Photo-current measurements show the relationships between illumination intensity, temperature, and wavelength of light. It is concluded that the ITO/Si structure forms a good Schottky-barrier structure with a large built-in voltage (over 1.0 eV at low temperatures). S C S

A78-51271 **Linear machine power requirements and system comparisons** E Abel, J L Mahtani, and R G Rhodes (Warwick University, Coventry, England) (*International Magnetism Conference, Florence, Italy, May 9-12, 1978*) *IEEE Transactions on Magnetics*, vol MAG-14, Sept 1978, p 918-920 7 refs

A study is conducted of the German magnetic levitation (Maglev) revenue vehicles. The study evaluates and compares total substation power required by the Germany revenue vehicle designs. The evidence suggests that the linear induction motor does not appear to be a good choice for a propulsion subsystem at 500 km/h or indeed at 400 km/h. The long stator motor does not perform well either when loaded at 400 km/h or run at 500 km/h. The electrodynamic-linear synchronous motor system, on the other hand, appears to show definite promise for the envisaged operating speed range from 400 to 500 km/h G R

A78-51316 # **The use of liquid dielectrics for the cooling of photoelectric converters (Ispol'zovanie zhidkikh dielektrikov dlia okhlazhdeniia fotopreobrazovatelei)** B A Bazarov, V D Tereshin, and A Pendzhiev (Akademiya Nauk Turkmensoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR) *Akademiya Nauk Turkmensoi SSR, Izvestiia, Seriya Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk*, no. 3, 1978, p 119-121. In Russian

The efficiency of several liquid coolants when applied to silicon solar cells was studied. The spectral sensitivity of the solar cells was determined for the following coolants: Freon-113, ethyl ether, and distilled water. It is found that Freon-113 is the best of the three, because of its spectral properties, chemical inertness with respect to the converter material, and nonflammability B J

A78-51321 **Neutron and X-ray diffraction investigation of deuterium storage in La₇Ni₃** P Fischer, W Halg (Eidgenossische Technische Hochschule, Würenlingen, Switzerland), L Schlapbach (Eidgenossische Technische Hochschule, Zurich, Switzerland), and K Yvon (Geneve, Universite, Geneva, Switzerland) *Journal of the Less Common Metals*, vol 60, July 1978, p 1-9 18 refs. Research supported by the Swiss National Science Foundation

According to quantitative phase analysis by neutron powder diffractometry, deuteration of La₇Ni₃ at room temperature leads to

the irreversible decomposition of the La_7Ni_3 into La_2O_3 and LaNi_5 . The D atoms are found to be distributed over the tetrahedral and octahedral interstices of the fcc metal atom arrangement, the D atoms occupying the octahedral interstices are not exactly at the center but appear to be shifted away from it along different directions. A reason for this delocalization is proposed. The determined structure of La_7Ni_3 is discussed with reference to other Th_7Fe_3 -type structures. M L

A78-51342 * Hydrogen from the solar photolysis of water. P R Ryason (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) *Energy Sources*, vol 4, no 1, 1978, p 1-22. 56 refs. Contract No. NAS-7-100.

Developments related to the study of photosynthesis are examined and aspects of photosensitization by solids are considered. It is pointed out that solids photosensitization for solar photochemical fuel formation is now an extremely active research area as a consequence of the promising results obtained with semiconductor photoelectrodes. The investigation of water decomposition schemes involving heterogeneous reactions is likely to be a productive area. As is the case for photosynthesis, the known examples of water decomposition by solids photosensitization involve charge separation processes immediately following light absorption. Homogeneous photoredox reactions are also discussed, taking into account thermochemical and photochemical cycles leading to the formation of a photooxidized ion, hydrogen quantum yields in the photo-oxidation aqueous ions, and thermochemical and photochemical cycles leading to the formation of a photoreduced ion. G.R.

A78-51343 Carbonate rock - A resource for energy. K. E. Haque (Department of Energy, Mines and Resources, Mineral Sciences Laboratories, Ottawa, Canada) *Energy Sources*, vol 4, no 1, 1978, p 77-84. 11 refs.

Carbonate rock is considered one of the major sources of carbon dioxide, capable of catalytic conversion to methane, synthetic natural gas (SNG), and other organic products. A brief account of various research reports available in the literature on the catalytic hydrogenation of carbon dioxide is included. Finally, carbon dioxide or, more specifically, carbonate rock is advanced as a potential source of products that might serve either as feedstocks for petrochemical industries or for production of energy. (Author)

A78-51396 # Optimization of the operation of a solar energy converter (Optimizatsiya rezhima preobrazovaniya solnechnoi energii). In V Mitishkin *Avtomatika i Telemekhanika*, July 1978, p. 53-60. 8 refs. In Russian.

Consideration is given to the automatic optimization of the operation of a solar energy converter (solar array, solar thermoelectric generator, etc.) in autonomous power-supply systems. The process of search for maximum power extracted from the converter by means of a pulsed automatic optimizer is investigated. A dc-converter with parallel switch is used in the power circuit of the optimizer. B J

A78-51398 # Algorithm and block diagram for controlling the modes of operation of a hydroelectric plant with energy storage in a large energy complex (Algoritmi i blok-skhem upravleniya rezhimami raboty GAES v energoob'edinenii). L A Karol', B I Silaev, and V M Rabinkii (Moskovskii Energeticheskii Institut, Moscow, USSR) *Energetika*, vol 21, June 1978, p 97-101. In Russian.

The paper presents the block diagram of an algorithm for optimizing the diurnal operations of a hydroelectric power plant with energy storage. This algorithm is part of the software of an automatic system of dispatcher control of the short-term operations of a power plant in a large energy complex. Some computational results are presented for the particular example of the Kiev hydroelectric plant, and recommendations relating to improvement of the algorithms are given. B J.

A78-51490 Solar power satellite developments. P E Glaser (Arthur D Little, Inc., Cambridge, Mass.) (*American Astronautical Society and Deutsche Gesellschaft für Luft- und Raumfahrt, Goddard Memorial Symposium, 16th, Washington, D C, Mar 8-10, 1978*) *Journal of the Astronautical Sciences*, vol 26, Apr-June 1978, p 101-127. 26 refs.

The terrestrial solar energy conversion methods capable of generating power continuously are reviewed and the rationale for solar energy conversion in geosynchronous orbit is outlined. The principles of the concept of solar power satellites (SPS) are presented and the technology options for converting solar energy in space, transmitting microwave power, and converting it on earth into electricity, are summarized. The development of the design concept of the SPS, based on solar thermal and photovoltaic conversion, is examined and salient characteristics are provided. The details of microwave power generation, beam transmission, and conversion to DC at the receiving antenna on earth are discussed. The requirements for a space transportation system, orbital construction and assembly, maintenance and operations are reviewed. The environmental impacts of SPS operation, such as stratospheric emission by space vehicles and atmospheric attenuation and scattering, ionospheric interactions, and biological effects of the microwave beam are highlighted. Economic and social issues are considered and the potential contribution of the SPS to meet future energy demands is projected. (Author)

A78-51501 An analysis on solar concentrators with a curvature determined by gravity and a mobile focal axis. G A Rottigni (Genova, Università, Genoa, Italy) *Nuovo Cimento C, Serie 1*, vol 1 C, May-June 1978, p 197-206. 5 refs.

The use of gravity to obtain a desired deformation of the surface of cylindrically symmetric solar concentrators is considered. Characteristics of east-west and north-south concentrators with gravity-determined curvatures are calculated and compared. The calculations suggest that the energy collected during the half-year March 21-September 21 by the 100-cm-diameter collector with the east-west axis is on the average about 25 percent more than that collected by the north-south collector, as a result of the greater operating interval for the east-west collector. M L

A78-51528 # Recent advances in solid state microwave devices. G Gibbons (Plessey Co., Ltd., Allen Clark Research Centre, Towcester, Northants, England). In European Microwave Conference, 7th, Copenhagen, Denmark, September 5-8, 1977, Proceedings. Sevenoaks, Kent, England, Microwave Exhibitions and Publishers, Ltd., 1978, p 71-82. 32 refs.

The current status of microwave solid-state devices is outlined with reference to GaAs FETs, InP TEDs, and Si TRAPATTs. Values are given for the carrier density profile of a GaAs FET layer as well as the noise figure versus the frequency, and added power versus frequency. It is noted that GaAs FET noise figures under 1.5 dB have been achieved in X-band. Studies of cathode contact and the fabrication of two-zone cathode structures have resulted in improved efficiency in transferred electron oscillators. Avalanche diodes are considered and it is shown that 30-35% efficiencies have been achieved in X-band using CW GaAs Read diodes and pulsed Si TRAPATTs. SCS

A78-51602 # Helium in soil gases of the Roosevelt Hot Springs Known Geothermal Resource Area, Beaver County, Utah. M E Hinkle, E H Denton, R C Bigelow, and R L Turner *Journal of Research*, vol 6, Sept-Oct 1978, p 563-569. 11 refs.

A78-51603 # CS₂ and COS in soil gases of the Roosevelt Hot Springs Known Geothermal Resource Area, Beaver County, Utah. M E Hinkle and T F Harms, *Journal of Research*, vol 6, Sept-Oct 1978, p 571-577. 7 refs.

A78-51621 # Turboexpanders for energy conservation J Holm and J S Swearingen (Rotoflow Corp., Los Angeles, Calif) *Mechanical Engineering*, vol 100, Sept 1978, p 34-40 13 refs

It is pointed out that significant amounts of energy are wasted in industrial and gas processing facilities where pressurized gas is reduced by throttling. Approaches for conserving energy are discussed, taking into account the various types of turbines and the design qualifications needed to meet energy conservation requirements. Attention is given to expander applications, efficiency considerations with respect to turbine design, the direct connected compressor, and arrangement consisting of a high-speed turboexpander and a generator, turboexpander qualities, variable flow control, the expansion of condensing streams, journal bearings, thrust bearing force meters, shaft seals, and the available sizes of turboexpanders. G R

A78-51674 Secondary batteries Recent advances R W Graham. Park Ridge, N.J., Noyes Data Corp. (Chemical Technology Review, No 106, Energy Technology Review, No 26), 1978 413 p \$42

Information drawn from U.S. patents issued since July 1975 is incorporated in this discussion of secondary batteries and their commercial technology. Topics include lead acid batteries, zinc electrodes and batteries, nickel-cadmium and other alkaline batteries, sodium-sulfur solid electrolyte batteries, lithium batteries, and other battery systems. Besides providing technical information, the book serves as a guide to U.S. patent literature, and a company index, an inventor index, and a U.S. patent number index are supplied. M L

A78-51713 # Corrosion behavior of type 310 stainless steel in coal-gasification environments O K Chopra and K Natesan (Argonne National Laboratory, Argonne, Ill.) In *Environmental degradation of engineering materials*, Proceedings of the Conference, Blacksburg, Va., October 10-12, 1977. Blacksburg, Va., Virginia Polytechnic Institute and State University, 1978, p 247-256 6 refs ERDA-supported research

A78-51776 Energy and resource recovery from industrial and municipal solid wastes Edited by G F Kroneberger (Envirotech Corp., Belmont and Menlo Park, Calif.) *AIChE Symposium Series*, vol 73, no 162, 1977 231 p \$20

A city view on solid waste management is considered along with a review of advanced solid-waste processing technology, a review of resource recovery technology, the operating experience of the Ames solid waste recovery plant, the effective separation of shredded municipal solid waste by elutriation, and the character and dewatering properties of sludges from water treatment. Attention is also given to processing of industrial waste for solar evaporation, metal and glass recovery from municipal solid waste, the chemistry of recycling aluminum, the outlook for recycling ferrous scrap from solid waste, pyrolysis and assessment of pyrolysis systems, operational experiences with the CPU 400 pilot plant, direct and indirect energy recovery via pyrolysis in multiple hearth furnaces, and the combined processing of wastewater and solid waste. G R

A78-51777 Review of advanced solid-waste processing technology D G Wilson (MIT, Cambridge, Mass.) *AIChE Symposium Series*, vol 73, no 162, 1977, p 16-30 62 refs NSF Grant No. GI-392278

Size reduction has become an accepted method of solid-waste processing. When applied to solid-waste processing, size reduction implies that large pieces of solid waste are torn, sheared, cut, or fractured, to produce smaller pieces. Baling by high pressure compaction is a viable process which can reduce the long-haul transportation costs of solid wastes and improve the properties of landfills. However, there is presently no known commercial baling operation which is profitable. Attention is also given to conventional incineration, fluidized-bed incineration, air-pollution control equipment, incineration with heat recovery, solid waste as supplementary fuel,

the conversion of solid wastes into a storable transportable fuel, separation processes, and composting. G R

A78-51778 A review of resource recovery technology B Morey and A Gupta (Occidental Research Corp., La Verne, Calif.) *AIChE Symposium Series*, vol 73, no 162, 1977, p 31-51 38 refs

The interface of separation technology on resource recovery is reviewed. The review briefly describes processes for making useful products from the organics. Since the specifications determine the quality of separation that must be achieved, a description of the markets is included. After a discussion of markets and the more widely explored processing techniques, two largely different systems are described that represent the range of resource recovery technology today. Attention is given to aspects of energy recovery, steam recovery, gas systems, gas from biological conversion, magnetic metals recovery, and wet processing. G R

A78-51779 Operating experience of the Ames Solid Waste Recovery Plant H D Funk and S H Russell (Henningson, Durham and Richardson, Inc., Omaha, Neb.) *AIChE Symposium Series*, vol 73, no 162, 1977, p 52-58

The Ames Solid Waste Recovery System consists of three major components, including the processing plant, the refuse derived fuel storage and retrieval system, and the power plant. In a discussion of the operation of the system, attention is given to aspects of materials flow, the ferrous metal fraction, the glass/grit fraction, wood chips, aluminum and nonferrous metals, the rejects fraction, the refuse fuel, questions of energy usage, operation under emergency conditions, and system costs. G R

A78-51780 Effective separation of shredded municipal solid waste by elutriation R M Hill (Triple/S Dynamics, Inc., Dallas, Tex.) *AIChE Symposium Series*, vol 73, no 162, 1977, p 59-61

Elutriation is defined as a washing action to purify, separate, or remove. The equipment used for elutriation is named 'VibroLutriator' to emphasize the true nature of an elutriation (or air washing) process using both mechanical vibration and air as contrasted with primitive air blast separators described by the familiar term 'aspiration'. The VibroLutriator differs from the ordinary aspirator in two very important respects. Material is moved through the treatment zones by vibration on a horizontal, or slightly inclined surface, and elutriation takes place in a deep and slow-moving, but turbulent, bed of material which is fluidized by all or part of the same air that entrains and conveys the light fraction out of the separating zone. G R

A78-51785 Pyrolysis and assessment of pyrolysis systems R C Bailie and D M Doner (West Virginia University, Morgantown, W Va.) *AIChE Symposium Series*, vol 73, no 162, 1977, p 102-119 41 refs

For clarification 'pyrolysis' has been defined as the term used for an irreversible chemical change brought about by the action of heat in an atmosphere devoid of oxygen. On the basis of this definition, it is found that of the various 'pyrolysis' systems considered only few involve pure pyrolysis. A review of waste pyrolysis systems is provided, taking into account four systems which are now on the verge of commercialization. It is pointed out that the pyrolysis of many materials including solid waste provides alternatives to incineration and can produce valuable products that can be piped or trucked considerable distances and used as a fuel or chemical raw material. G R

A78-51786 Operational experiences with the CPU-400 pilot plant R H VanderMolen and G L Wade (Combustion Power Co., Inc., Menlo Park, Calif.) *AIChE Symposium Series*, vol 73, no 162, 1977, p 120-132

A solid fueled gas turbine pilot plant has been constructed and operated by the Combustion Power Company in Menlo Park, California. This plant has proven the reality of combusting solid fuels

such as high sulfur coal, industrial wood waste, and municipal refuse, in a pollution-free manner, in a gas turbine cycle. The plant is described and operating data are discussed. The plant status and major problem areas are also detailed. (Author)

A78-51787 Direct and indirect energy recovery via pyrolysis in Multiple Hearth Furnaces. G. F. Kroneberger (Envirotech Corp., Belmont and Menlo Park, Calif.) *AIChE Symposium Series*, vol 73, no 162, 1977, p 133-142.

The use of the Multiple Hearth Furnace (MHF) for pyrolysis applications is discussed. Design details of the MHF are provided and a process description is presented. Attention is given to aspects of nomenclature, thermal energy considerations, proven types of pyrolysis, the equipment used for the processing of sludge and refuse derived fuel, and observations regarding pyrolysis in general. It is pointed out that for 'high heat' feed materials the pyrolysis process is much easier to control than an incineration process. The segregation of solid wastes into re-useable resources and the recovery of the energy from the remainder, maximizes the environmental benefits of this previously troublesome 'waste'. G. R.

A78-51788 Combined processing of wastewater and solid waste. R. B. Sieger and B. D. Bracken (Brown and Caldwell, Walnut Creek, Calif.) *AIChE Symposium Series*, vol 73, no 162, 1977, p 143-149. 5 refs.

A description is given of a process involving the combustion and pyrolysis of sewer sludge and refuse-derived fuel (RDF). The process utilizes a fully automated, dry classification type, resource recovery plant to provide RDF from the combustible fraction of solid waste while recovering ferrous metals and aluminum. The RDF is pneumatically conveyed to the water reclamation plant site for storage and use as fuel in the multiple hearth sewage sludge furnaces. The heat of combustion of the furnace exhaust is recovered by waste heat boilers to produce steam. Some of the steam is used to drive steam turbines for aeration blowers, electrical generators, and various mechanical drives. The remaining steam is used to satisfy treatment plant heating and cooling loads. G. R.

A78-51789 Pyrolysis of municipal solid waste to fuels and chemicals. N. W. Snyder (Ralph M. Parsons Co., Pasadena, Calif.) *AIChE Symposium Series*, vol 73, no 162, 1977, p 150-159. 9 refs.

A description is presented of a number of systems which can dispose of sewage sludge along with refuse. Municipal solid waste collected for disposal contains approximately 75% organics, which are mostly cellulosic. Aspects of resource recovery are examined. Recovery of energy by pyrolysis is accomplished by the thermal decomposition of organic matter into gases, oil, and char in an oxygen free atmosphere. Attention is given to pyrolysis systems, the Purox system and nitrogen-free synthesis gas utilization, occidental flash pyrolysis, the Monsanto/Landgard system, the Andco-Torrex system, construction and operating costs, and thermal efficiencies. G. R.

A78-51790 Union Electric's solid waste utilization system. D. L. Klumb and P. R. Brendel (Union Electric Co., St. Louis, Mo.) *AIChE Symposium Series*, vol 73, no 162, 1977, p 160-167.

A solid waste utilization system for the St. Louis region, including the City of St. Louis, is considered. Public and private trash haulers are employed in connection with the collection and the transport of the trash. The trash will be dumped in conveyor dumping pits or on the floor at a transfer station. The solid waste will be loaded into rail car containers and be brought to the processing plants by means of special trains. Attention is given to the processing facilities, the boiler charging systems, solid waste characteristics, and bottom ash and fly ash characteristics. G. R.

A78-51791 Technology options in thermal processing of organic hazardous wastes. R. D. Ross (Read-Ferry Co., Inc., Haddonfield, N.J.) *AIChE Symposium Series*, vol 73, no 162, 1977, p 176-187.

It is assumed that the majority of wastes from process applications are hazardous in one way or another. A classification of the considered wastes involves the determination of the nature of the waste, and a determination of its degree of toxicity. There are three basic recovery possibilities in any thermal processing operation. The first is heat value, the second is related to the chemical value, and the third takes into account the fuel value. A description of the currently available systems is presented, giving attention to the fluid bed incinerator, a process for recovering carbonate salts in the wet form, and the combustion process of a chlorinated or fluorinated waste system. The present status of pyrolytic systems is also examined. G. R.

A78-51792 Recovery and use of products from petroleum treating wastes. R. E. Maple and A. R. Price (Merichem Co., Houston, Tex.) *AIChE Symposium Series*, vol 73, no 162, 1977, p 200-206.

A78-51814 Energy use and climatic changes. J. Williams and W. Hafele (International Institute for Applied Systems Analysis, Laxenburg, Austria.) (*International Astronautical Federation, International Astronautical Congress, 28th, Prague, Czechoslovakia, Sept 25-Oct 1, 1977.*) *Acta Astronautica*, vol 5, July-Aug 1978, p 589-600. 51 refs.

The potential impact of the large-scale use of solar, nuclear, and fossil-fuel (coal) energy options on global climate is discussed. The role of space observations in the evaluation of the impact of energy systems on climate is considered and shown to be significant. The impact on climate is examined for waste heat, increased atmospheric CO₂ levels, and solar energy conversion systems such as solar thermal electric conversion, ocean thermal energy conversion, photovoltaic conversion, biomass conversion, and solar satellite power systems. Results of sensitivity tests with numerical models of atmospheric circulation are noted which suggest that the release of large amounts of waste heat would cause hemispheric or global climate changes, that fossil-fuel systems would lead to an increase in atmospheric CO₂, and that solar energy conversion systems would also cause climate changes if employed on a large scale. F. G. M.

A78-51818 Projections of the price of hydrogen fuel. J. O. Bockris (South Australia, Flinders University, Adelaide, Australia.) *International Journal of Energy Research*, vol 2, Jan-Mar 1978, p 9-17. 23 refs.

The cost of hydrogen obtained by various procedures is estimated. In an expression for the cost of 1 MBTU of hydrogen by electrolysis, the cost is set equal to the sum of a constant and a constant times the product of the voltage and the cost. Cost predictions for hydrogen obtained using photovoltaic electricity, coal, chemical processes for water, new electrochemical processes, improved electrolysis of water, electrolysis at very high temperature, photoelectrochemical production, photosynthesis, and aerogeneration are discussed. The cost of electricity under relevant circumstances is examined, and the cost of hydrogen storage is considered. M. L.

A78-51819 Solar energy conversion through phase transformations. R. C. Srivastava (Birla Institute of Technology and Science, Pilani, India), A. S. N. Murthy, and G. R. Saini (Indian Institute of Technology, New Delhi, India.) *International Journal of Energy Research*, vol 2, Jan-Mar 1978, p 43-45. 12 refs.

Sodium thiosulphate pentahydrate and sodium sulphate decahydrate show appreciable potential differences and currents when the solid phase is in contact with its molten phase. The studies offer a new method for converting solar energy into electrical power. (Author)

A78-51906 Solar cells for terrestrial communications. I. (Solargeneratoren in der terrestrischen Nachrichtentechnik. I.) E. Sommer (Fachbeirat Laser-Optoelektronik, Bonn, West Germany.) *Nachrichten Elektronik*, vol 32, Apr 1978, p 115-118. In German.

The significance of solar cells for powering communication systems in remote areas will increase dramatically during the next

few years. This paper discusses the advantages and disadvantages of solar-cell power sources and compares them with other energy sources. A number of applications of solar cells in terrestrial communication systems are examined. B J

A78-51909 Solar cells for terrestrial communications II (Solargeneratoren in der terrestrischen Nachrichtentechnik II) E Sommer (Fachbeirat Laser-Optoelektronik, Bonn, West Germany) *Nachrichten Elektronik*, vol 32, May 1978, p 159, 160. In German.

The present use of solar arrays to power terrestrial communication systems is reviewed. Consideration is given to such applications as educational television, radio receivers in remote areas without power lines, and military applications. B J

A78-51926 Intraregional variations of solar radiation in the eastern United States M A Atwater and J T Ball (Center for the Environment and Man, Inc., Hartford, Conn.) *Journal of Applied Meteorology*, vol 17, Aug 1978, p 1116-1125. 16 refs. NSF Grants No. ATM-76-09581, No. AER-75-14536.

Data generated by a physically based solar radiation model consisting of hourly values of total and direct-beam solar radiation were computed at nearly 50 stations in the United States for the years 1971 and 1972. The radiation model used in the computations includes the effects of Rayleigh scattering, absorption by water vapor and permanent gases, and absorption and scattering by clouds and aerosols. Random and systematic variations of total solar radiation are presented for the eastern United States. Errors in computed radiation on a daily basis were less than distance-induced random variations for distances of no less than about 100 km. Systematic intraregional differences in monthly solar radiation of between 15% and 30% were computed within distances of 200 km in the eastern United States. The spatial distribution of total solar radiation is significantly influenced by coastal-inland and urban-rural climatic differences, with radiation minima computed for some large cities.

(Author)

A78-51943 Photoconductivity and Dember effect in Zn3P2 J M Pawlikowski, N Mirowska, and F Krolicki (Wroclaw, Politechnika, Wroclaw, Poland) *Infrared Physics*, vol 18, July 1978, p 343-346. 11 refs. Research sponsored by the Politechnika Wroclawska.

The photoelectric properties of Zn3P2 monocrystals in photoconductivity and Dember photovoltaic modes have been investigated in the 0.5-1.2-micron wavelength range. The analysis of long-wave edge and a possible application as a high-sensitivity detector are presented.

(Author)

A78-51977 # Solar power satellite construction and maintenance-- The first large-scale use of man-in-space K H Miller and E Davis (Boeing Aerospace Co., Seattle, Wash.) *American Institute of Aeronautics and Astronautics, Conference on Large Space Platforms Future Needs and Capabilities*, Los Angeles, Calif., Sept 27-29, 1978, Paper 78-1637. 10 p.

The 10 GWe photovoltaic solar power satellite concept developed by NASA and Boeing Aerospace Company is described. Current construction and maintenance approaches are discussed. This concept requires several hundred people working in space. They will be located at a low-earth-orbit construction base, a geosynchronous earth-orbit final assembly base, or on the satellites performing maintenance. The text includes discussions of crew jobs, work schedules, rotation, transportation, productivity, and other human factors considerations.

(Author)

A78-51981 * # Design concept of geostationary platform E C Hamilton and W T Carey, Jr (NASA, Marshall Space Flight Center, Huntsville, Ala.) *American Institute of Aeronautics and Astronautics, Conference on Large Space Platforms Future Needs and Capabilities*, Los Angeles, Calif., Sept 27-29, 1978, Paper 78-1642. 8 p.

The payload efficiency of communication satellites has typically averaged 25 to 30% while meteorology and earth observation

satellites range from 30 to 35%. Improvement in solar cell efficiency, batteries, electric propulsion for stationkeeping, and solid-state circuitry will increase this efficiency in the future, but it will still be advantageous in the Shuttle era to reduce the expenditure for support systems. A platform that provides all the support functions could reduce the initial cost due to economics of scale and also reduce transportation cost. Three alternate configurations of a platform for geosynchronous orbit communications and meteorology missions are presented.

(Author)

A78-51982 * # Large space structures at the Marshall Space Flight Center J K Harrison and C R Darwin (NASA, Marshall Space Flight Center, Huntsville, Ala.) *American Institute of Aeronautics and Astronautics, Conference on Large Space Platforms Future Needs and Capabilities*, Los Angeles, Calif., Sept 27-29, 1978, Paper 78-1650. 18 p.

The Space Shuttle will provide a new capability for the construction in space of structures too large to be accommodated in the Shuttle bay. To understand and develop this new capability several construction methods and design approaches are being studied by MSFC and industry. This paper relates the general scope of these ongoing activities, the project aims and objectives, and a discussion of many design and equipment variables. Major design and construction variables, such as on-orbit or ground fabricated construction and type of materials to be used, are discussed relative to their status and applicability to various designs. Construction methods and options are reviewed and many of the support equipments under study or development are described.

(Author)

A78-51999 * # Thermal control requirements for large space structures M Manoff (Rockwell International Corp., Downey, Calif.) *American Institute of Aeronautics and Astronautics, Conference on Large Space Platforms Future Needs and Capabilities*, Los Angeles, Calif., Sept 27-29, 1978, Paper 78-1675. 7 p. Contract No. NAS1-14116.

Performance capabilities and weight requirements of large space structure systems will be significantly influenced by thermal response characteristics. Analyses have been performed to determine temperature levels and gradients for structural configurations and elemental concepts proposed for advanced system applications ranging from relatively small, low-power communication antennas to extremely large, high-power Satellite Power Systems (SPS). Results are presented for selected platform configurations, candidate strut elements, and potential mission environments. The analyses also incorporate material and surface optical property variation. The results illustrate many of the thermal problems which may be encountered in the development of three systems.

(Author)

A78-52001 * # Solar power satellites - Heat engine or solar cells H Oman and D L Gregory (Boeing Aerospace Co., Seattle, Wash.) *American Institute of Aeronautics and Astronautics, Conference on Large Space Platforms Future Needs and Capabilities*, Los Angeles, Calif., Sept 27-29, 1978, Paper 78-1684. 8 p. 5 refs. Contract No. NAS9-15196.

A solar power satellite is the energy-converting element of a system that can deliver some 10 GW of power to utilities on the earth's surface. We evaluated heat engines and solar cells for converting sunshine to electric power at the satellite. A potassium Rankine cycle was the best of the heat engines, and 50 microns thick single-crystal silicon cells were the best of the photovoltaic converters. Neither solar cells nor heat engines had a clear advantage when all factors were considered. The potassium-turbine power plant, however, was more difficult to assemble and required a more expensive orbital assembly base. We therefore based our cost analyses on solar-cell energy conversion, concluding that satellite-generated power could be delivered to utilities for around 4 to 5 cents a kWh.

(Author)

A78-52005 * # The 25 kW power module - First step beyond the baseline STS. G W Mordan (NASA, Marshall Space Flight Center, Huntsville, Ala.) *American Institute of Aeronautics and Astronautics, Conference on Large Space Platforms Future Needs and Capabilities, Los Angeles, Calif., Sept 27-29, 1978, Paper 78-1693* 6 p

The backbone of the first reusable Space Transportation System (STS) is the Space Shuttle. The 25 kW Power Module is currently being defined by NASA as the first significant increment in capability beyond the baseline STS and is to be available for use in 1983. The Power Module is an orbit-based space system which will augment the capability of the Space Shuttle Orbiter to support Spacelab sortie missions and will provide a unique free-flying mode for a variety of payloads which require high capability, long duration, and man-tended operation. The Power Module will make it possible for the Space Shuttle Orbiter and Spacelab to remain on-orbit for periods of time significantly in excess of that provided by the baseline STS (7 days) without major penalty to the Shuttle and its payload. G R

A78-52076 The physics of MHD generators. A V Nedospasov (Akademii Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) (*Uspekhi Fizicheskikh Nauk*, vol. 123, Oct 1977, p 333-348.) *Soviet Physics - Uspekhi*, vol. 20, Oct 1977, p 861-869. 13 refs. Translation.

Physical phenomena occurring in plasma MHD electrical-energy generators are reviewed. Distinctions between closed- and open-cycle MHD generators are summarized, the mechanism of interaction between a weakly ionized gas and a transverse magnetic field is examined, and the major possible instabilities of such a flow are explained qualitatively along with various effects arising near the electrodes. Some properties of the plasma in MHD generators with nonequilibrium conductivity are discussed, including ionization turbulence, ionization-front propagation through the weakly ionized gas, and ionization-front stabilization at the MHD-channel inlet. Data are presented which illustrate recent achievements in open-cycle MHD generator development. F G M

A78-52083 # The behavior of Arken nucleus plumes from coal-fired power plants in the Midwest. A H Auer, Jr and M J Komp (Wyoming, University, Laramie, Wyo.) In Joint Conference on Applications of Air Pollution Meteorology, Salt Lake City, Utah, November 29-December 2, 1977, Preprints. Boston, Mass., American Meteorological Society, 1978, p 29-32. 6 refs. NSF Grant No. AEN-73-07881.

A78-52125 # Evaluation of the Gaussian plume model at Maryland power plants. J C Weil (Martin Marietta Laboratories, Baltimore, Md.) In Joint Conference on Applications of Air Pollution Meteorology, Salt Lake City, Utah, November 29-December 2, 1977, Preprints. Boston, Mass., American Meteorological Society, 1978, p 305-314. 18 refs. Research supported by the Maryland Power Plant Siting Program.

A78-52136 # Regional air quality assessment for coal-related energy development in the Northwest. D L Elliott and D S Renné (Battelle Pacific Northwest Laboratories, Richland, Wash.) In Joint Conference on Applications of Air Pollution Meteorology, Salt Lake City, Utah, November 29-December 2, 1977, Preprints. Boston, Mass., American Meteorological Society, 1978, p 386-391. 12 refs. Contract No. EY-76-C-06-1830.

A78-52146 * # Alternative approaches to plasma confinement. J R Roth (NASA, Lewis Research Center, Cleveland, Ohio) *IEEE Transactions on Plasma Science*, vol. PS-6, Sept 1978, p 270-295. 78 refs.

The paper discusses 20 plasma confinement schemes each representing an alternative to the tokamak fusion reactor. Attention is given to: (1) tokamak-like devices (TORMAC, Topolotron, and the Extrap concept), (2) stellarator-like devices (Torsatron and twisted-

coil stellarators), (3) mirror machines (Astron and reversed-field devices, the 2XII B experiment, laser heated solenoids, the LITE experiment, the Kaktus-Surmac concept), (4) bumpy tori (hot electron bumpy torus, toroidal minimum-B configurations), (5) electrostatically assisted confinement (electrostatically stuffed cusps and mirrors, electrostatically assisted toroidal confinement), (6) the Migma concept, and (7) wall confined plasmas. The plasma parameters of the devices are presented and the advantages and disadvantages of each are listed. S C S

A78-52149 Diffusive losses and scaling law for large tokamaks. C R Harder and D K Bhadra (General Atomic Co., San Diego, Calif.) *IEEE Transactions on Plasma Science*, vol. PS-6, Sept 1978, p 317-328. 15 refs. Contract No. EY-76-C-03-0167 PA 38.

The paper discusses a multiparameter model for plasma diffusion in a reactor size tokamak device. Limitations to density and temperature due to global hydromagnetic equilibrium and macrostability requirements are noted. Consideration is given to the collisionless regime where plasma energy degradation is primarily due to microinstabilities caused by trapped electrons and ions. With reference to a reactor using scaling concepts, ignition and burn equilibrium are outlined within the framework of a time-dependent zero space-dimensional computer code. Results are given for confinement scaling, reactor power and density development in time, and the attainment of burn equilibrium. S C S

A78-52193 Primary Li/SOCl₂ cells. IV - Cathode reaction profiles. A N Dey and P Bro (P R Mallory and Co., Inc., Laboratory for Physical Science, Burlington, Mass.) (*Electrochemical Society, Meeting, Las Vegas, Nev., Oct 17-22, 1976*) *Electrochemical Society, Journal*, vol. 125, Oct 1978, p 1574-1578. 11 refs.

The Li/SOCl₂ inorganic electrolyte system is one of the highest energy density systems known to date. The system consists of a Li anode, a porous carbon cathode, and an LiAlCl₄-SOCl₂ electrolyte. The reported investigation had the objective to determine the reaction profiles (both cross-sectional and longitudinal) of the porous carbon cathodes used in the Li/SOCl₂ D cells to assess its performance-limiting characteristics in some detail. The ultimate objective of these studies is to improve the porous carbon cathodes so that they may perform efficiently at high current densities, thus possibly eliminating the need of two types of cells for high and low rate applications. The obtained cross-sectional reaction profiles of the carbon cathodes show that mass transport through the porous carbon is the limiting feature of the cathodes. G R

A78-52195 S/Se substitution in polycrystalline CdSe photoelectrodes - Photoelectrochemical energy conversion. D Cahen, G Hodes, and J Manassen (Weizmann Institute of Science, Rehovot, Israel) *Electrochemical Society, Journal*, vol. 125, Oct 1978, p 1623-1628. 20 refs. U.S.-Israel Binational Science Foundation Grant No. 1314.

A description is presented of results which have been obtained by X-ray photoelectron spectroscopy (XPS). The results show the occurrence of S/Se substitution both in the light and in the dark. Additional evidence is given which supports such a substitution and the resulting effect of it on the conversion efficiency and stability of CdSe electrodes in polysulfide solutions. The mechanism of the substitution is discussed. On the basis of the obtained data a band scheme is presented for the polysulfide electrolyte CdS-CdSe system in which the CdS layer is considered as essentially an insulator. The substitution phenomenon is used as a basis for an explanation of the difference in behavior between polycrystalline and single crystal electrodes taking into account also the short- and long-term changes in photovoltage and photocurrents obtained from such a photoelectrochemical cell. G R

A78-52198 * Recovery of shallow junction GaAs solar cells damaged by electron irradiation. G H Walker and E J Conway (NASA, Langley Research Center, Hampton, Va.) *Electrochemical Society, Journal*, vol. 125, Oct 1978, p 1726, 1727.

Solar cells operated in space are subject to degradation from electron and proton radiation damage. It has been found that for deep junction p-GaAlAs/p-GaAs solar cells some of the electron radiation damage is removed by annealing the cells at 200 C. The reported investigation shows that shallow junction p-GaAlAs/p-GaAs/n-GaAs heteroface solar cells irradiated with 1 MeV electrons show a more complete recovery of short-circuit current than do the deep junction cells. The heteroface p-GaAlAs/p-GaAs/n-GaAs solar cells studied were fabricated using the etch-back epitaxy process.

G R

A78-52236 Numerical modeling of a desaturating geothermal reservoir. R. N. Horne (Stanford University, Stanford, Calif.) and M. J. O'Sullivan (Auckland University, Auckland, New Zealand). *Numerical Heat Transfer*, vol 1, Apr-June 1978, p 203-216. 15 refs. New Zealand Energy Research and Development Committee Contract No. 3039.

The Wairakei geothermal field is modeled in a single-phase axisymmetric representation in which fluid is withdrawn through bores grouped around the axis and replaced at the surface. Assumptions include the Boussinesq property, negligibility of inertial effects, constant viscosity and constant thermal expansion coefficient. Drawdown and production are modeled. The model is run for two operating procedures: dwindling production over a long period of time, and sustained production over a shorter period. P. T. H.

A78-52252 # Wind power resources and methods for evaluating them (Vetroenergeticheskie resursy i metody ikh otsenki). L. E. Anapol'skaia and L. S. Gandin (Glavnaia Geofizicheskaya Observatoriia, Leningrad, USSR). *Meteorologiya i Gidrologiya*, July 1978, p 11-17. 5 refs. In Russian.

The described procedure for evaluating the attainable wind power utilization for given climatic conditions uses data on the statistical distribution of wind velocity patterns as well as wind-power generator parameters. It is demonstrated that the annual variation in air density can be ignored in the calculation of mean annual wind power resources. Calculations of climatic mean annual wind power resources for a number of areas with strong winds are reported, and the likelihood of utilizing wind power in the USSR is examined.

M L

A78-52500 Fluidized-bed energy technology: Coming to a boil. W. C. Patterson and R. Griffin. Research supported by the U.S. Department of Energy and Rockefeller Brothers Fund. New York, INFORM, Inc., 1978. 141 p. 47 refs. \$45.

Fluidized-bed combustion may play a significant role in permitting the burning of coal in an environmentally acceptable manner, a step forward towards the widespread use of clean technologies. Additionally, this technology offers the user flexibility in burning virtually any type of fuel, individually or simultaneously, without significant boiler modifications. A review is presented of the worldwide status of research, development, demonstration, and commercialization of fluidized bed combustion. Attention is given to the basic principles of fluidized-bed operation, aspects of historical development, environmental implications, prospects for commercialization, and the profiles of major organizations with respect to fluidized-bed combustion research and developments.

G R

A78-52548 Performance and NOx emissions of spark ignited combustion engines using alternative fuels - Quasi one-dimensional modeling. II - Methanol fueled engines. M. B. Rubin and W. J. McLean (Cornell University, Ithaca, N.Y.). *Combustion Science and Technology*, vol 18, no 5-6, 1978, p 199-206. 19 refs. U.S. Department of Transportation Grant No. OS-30113.

A thermodynamic model employing a one-dimensional semi-empirical flame speed has been used to evaluate methanol as a reciprocating engine fuel. The empirical parameters in the flame speed were determined by matching computed combustion durations with experimental values reported in the literature. Satisfactory agreement was obtained between predicted and measured values for power, efficiency and NOx emissions. The model predicts maximum

thermal efficiency of the methanol engine for equivalence ratios in the 0.7 to 0.8 range. This is within practical operating range, as experiments have shown the lean misfire limit to be near an equivalence ratio of 0.6. No emissions are predicted to reach a maximum near an equivalence ratio of 0.9 and are reduced by about two-thirds at an equivalence ratio of 0.75. Addition of water to methanol is shown to significantly reduce NOx emissions, although with some loss in thermal efficiency. Improved fuel economy without excessive NOx emissions can be obtained by employing methanol-water blends at high compression ratios. (Author)

A78-52550 Synthesis and flammability limits of low-Btu gas mixtures. W. M. Heffington (Texas A & M University, College Station, Tex.). *Combustion Science and Technology*, vol 18, no 5-6, 1978, p 229-233. 23 refs. Research supported by Texas A & M University.

Representative low-Btu gas mixtures derived from coal are presented and simplified, resulting in synthetic low-Btu gas mixtures composed of H₂, CO, CH₄, and CO₂. Mine-atmosphere flammability data are applied to the synthetic mixtures to produce flammability limits at one atmosphere and 77 F. Two-component synthetic mixtures of CH₄ and an inert gas are shown to be not suitable for certain combustion experiments requiring low-Btu gases. (Author)

A78-52597 OTEC - Electricity from the ocean. W. F. Whitmore (Lockheed Missiles and Space Co., Inc., Sunnyvale, Calif.). *Technology Review*, vol 81, Oct 1978, p 58-63.

Although thermodynamically inefficient (2.5%), OTEC plants become competitive in view of the fact that the fuel (sun's energy) is free. Major cost element is the massive heat exchangers operating at 40 F temperature differences of less than 40 F. A design for a single 25-MW modular unit requires about 640 miles of two-inch tubing, in either aluminum or titanium. Methods of removing slime from the heat exchangers without detriment to marine environment are being developed. The current estimate for the cost of a moored OTEC plant is about \$2000/kW capacity, with costs decreasing with improvements in heat exchangers.

P. T. H.

A78-52599 Specific energy consumption of the transport modes - A new systematic consideration (Spezifischer Energieverbrauch der Verkehrsträger - Eine neue systematische Betrachtung). K. Bauermeister (Deutsche Bundesbahn, Frankfurt am Main, West Germany). *Elektrische Bahnen*, vol 49, Sept 1978, p 220-224. In German.

The data regarding the specific energy consumption of the modes of transport reported from different sources are listed in a table. It is found that values for the same mode of transport provided by different investigations differ from each other within a comparatively wide range. Ratios of 1.4 are observed, for instance, for values concerning the specific energy consumption in the case of buses. Even greater variations are observed for the values determined for the specific energy consumption in the transportation of freight. It appears, therefore, that the considered data do not provide a satisfactory basis to derive reliable conclusions regarding the relative standing of two modes of transport with respect to the consumption of primary energy involved in a specific case involving the transport between two given locations. To obtain values which can be used for such evaluations it will be necessary to take into account the specific conditions for which the values have been determined. Attention is in this connection given to study which is concerned with the general, intermediate, and fine structure of transport relations. G. R.

A78-52625 Graded band-gap pAl(x)Ga(1-x)As-nGaAs heterojunction solar cells prepared by molecular beam epitaxy. N. Matsunaga and K. Takahashi (Tokyo Institute of Technology, Tokyo, Japan). *International Journal of Electronics*, vol 45, Sept 1978, p 273-282. 9 refs.

Molecular beam epitaxy is used to fabricate graded band-gap pAl(x)Ga(1-x)As-nGaAs heterojunction solar cells. The composition profile is examined by Auger electron spectroscopy with ion

sputter-etching and ion microprobe analysis. For the alloy obtained by varying the temperature of effusion cells linearly with time, the profile becomes ideal so as to drive carriers generated near the surface toward the junction. In the presence of the internal electric field, the carriers generated near the surface by shorter-wavelength photons are collected effectively before they recombine through the surface states, so that the collection efficiencies are substantially improved. The spectral response of the graded band-gap cell compared with abrupt heterojunction cells with $\text{Al}(x)\text{Ga}(1-x)\text{As}$ layers of uniform composition shows the improvement of the collection efficiency in the region of shorter wavelength as well as the effect of the internal electric field. S D

A78-52721 **Underground coal gasification.** D W Gregg (California, University, Livermore, Calif.) and T F Edgar (Texas, University, Austin, Tex.) *AICHE Journal*, vol 24, Sept 1978, p 753-781. 142 refs. Research supported by the U.S. Department of Energy, Continental Oil Co., Mobil, Texas Utilities, Shell Oil Co., Dow Chemical Co., Atlantic Richfield Co., SUNEDCO, Lone Star Gas, DuPont de Nemours and Co., and NSF.

The historical development of underground coal gasification is examined and the field design of an underground coal gasification system is considered, taking into account the Soviet system for underground coal gasification, the significance of enhanced coal permeability, a field design for steeply dipping coal seams, a field design for horizontal coal seams, the critical channel width, the maintenance of constant composition of product gas, and aspects of system efficiency. The chemistry and physics of underground coal gasification are considered along with the plastic properties of coal and their importance to underground coal gasification, current field testing results, and the modeling of underground coal gasification. Attention is given to aspects of system identification, chemical composition models, and heat transfer and channel growth during in situ gasification. G R

A78-52722 **A model for moving-bed coal gasification reactors.** H Yoon (Delaware, University, Newark, Del.), Conoco Coal Development Co., Libraryville, Pa.), J Wei (Delaware, University, Newark, Del.), MIT, Cambridge, Mass.), and M M Denn (Delaware, University, Newark, Del.) *AICHE Journal*, vol 24, Sept 1978, p 885-903. 58 refs. Research supported by the Electric Power Research Institute.

A steady state model of moving-bed coal gasification reactors has been developed. Model predictions are in agreement with published commercial plant data for Lurgi pressurized gasification reactors and a pilot plant slagging gasifier. The dependence of reactor performance on operating variables has been studied for Illinois and Wyoming coals. For a given coal, maximum efficiency is determined by the coal-to-oxygen feed ratio. The location of the maximum temperature, which defines the combustion zone, is an important operating variable. Efficient operation of the dry ash reactor cannot be carried out below a critical feed gas temperature because of insufficient gasification and excessive carbon loss in the ash.

(Author)

A78-52742 # **Automatic fabrication of large space structures - The next step.** W K Muench (Grumman Aerospace Corp., Bethpage, N.Y.) *American Institute of Aeronautics and Astronautics, Conference on Large Space Platforms: Future Needs and Capabilities*, Los Angeles, Calif., Sept 27-29, 1978, Paper 78-1651. 8 p.

An outline is presented of a plan which will lead to the establishment of an operational five giga watt solar power satellite in space. A detailed description is presented of the first stage of this plan. This stage is concerned with the development of a machine that is to be employed to produce the basic building block beams in space, which are used in the assembly of the large space structures required. A ground demonstration version of this machine has already been completed. After the feasibility of automatically producing beams has been successfully demonstrated, questions arise concerning the next step which has to be taken. One possible answer

to this question is discussed, taking into account the development of a special end effector for the Space Shuttle's remote manipulator system. G R

A78-52746 * **Photovoltaic power-system options for the manned space construction base.** G G McKhann (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.) *American Institute of Aeronautics and Astronautics, Conference on Large Space Platforms: Future Needs and Capabilities*, Los Angeles, Calif., Sept 27-29, 1978, Paper 78-1683. 20 p. 7 refs. Contract No. NAS9-14958.

The function of the proposed manned Space Construction Base (SCB) is to provide a permanent manned orbital facility for the construction and operation of a variety of space experiments, ranging from a space-processing development to on orbit constructed microwave radiometers and antennas. A typical SCB system might reach initial operational capability in low earth orbit in 1985, have a 10-year mission duration, and have an initial power requirement of 50 kW. A summary of the requirements imposed by the SCB on the electrical power system (EPS) is presented in a table. Attention is given to EPS options, baseline power platform system operations, an energy storage system evaluation, advanced-technology NiCd batteries and lifetime, and orbital buildup operations. G R

A78-52764 # **Steady-state action magnetoplasmodynamic source (Magnitoplazmodinamicheskii istochnik statsionarnogo deistviya).** V S Ermachenko, F B Iurevich, M N Rolin, A Ia Venger, and V N Borisiuk (Akademiya Nauk Belorusskoi SSR, Institut Teplo i Massoobmena, Minsk, Belorussian SSR) *Inzhenerno-Fizicheskii Zhurnal*, vol 35, Sept 1978, p 459-465. 10 refs. In Russian.

The paper describes a magnetoplasmodynamic generator with magnetic arc, the generator operates at powers ranging up to 400 kW. Experimental results are presented on the electrical and thermal properties of the generator. Volt-ampere characteristics as well as mean-mass enthalpy are studied as a function of power supplied to the arc, magnetic flux density in the discharge region, and working gas flow rate. B J

A78-52770 # **Rankine-cycle systems with organic working fluids and prospects of the application of such systems in the solar energy field (Review).** (Paroturbinnnye ustanovki s organicheskimi rabochimi telami i perspektivy ikh primeneniya v gelioenergetike (Obzor)) V A Grilikhes, M M Grishutin, and V S Evseev. *Geliotekhnika*, no 4, 1978, p 3-18. 43 refs. In Russian.

The basic characteristics of cycles and energy converters for Rankine cycle electric energy systems with organic heat-exchange fluids are surveyed. Consideration is also given to the basic design features of such systems, with emphasis on the heat exchange equipment (steam generators, regenerators, and condensers). The application of such organic systems to the production of electric power from low-potential heat sources - solar radiation, geothermal waters, and industrial waste heat - is considered. It is found that the use of organic heat-exchange fluids will lead to considerable cost-savings. B J

A78-52771 # **Thermodynamic analysis of a combined gas-turbine-thermoelectric solar energy converter (Termodinamicheskii analiz kombinirovannogo GTU-TEG preobrazovatelja solnechnoi energii).** L M Drabkin (Tashkentskii Institut Zheleznodorozhnogo Transporta, Tashkent, Uzbek SSR) *Geliotekhnika*, no 4, 1978, p 19-22. In Russian.

Consideration is given to the thermodynamic cycle of a solar energy system consisting of a thermoelectric generator connected to a gas turbine. Expressions are obtained for the efficiency and specific area of the refrigerator-radiator of such a system. This combined scheme is compared with a Brayton-cycle system with respect to optimization in terms of efficiency and specific area. B J

A78-52772 # Optimization of the exponential distribution of dopant in the base of a semiconductor photocell (Optimizatsia eksponentsial'nogo raspredelenia legiruiushchei primesi v baze poluprovodnikovogo fotopreobrazovatelya) V M Evdokimov and Iu D Lisovskii (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istoknikov Toka, Moscow, USSR) *Geliotekhnika*, no 4, 1978, p 23-29 17 refs In Russian

A theoretical analysis is presented of the effect of the uniform electric field produced by an exponential distribution of dopants in the base of a photocell of finite thickness on the accumulation of charge carriers. It is assumed that the mobility and lifetime of carriers depend in power law fashion on dopant concentration. An optimal field strength is determined and the dependence of the field on the parameters of the semiconductor and the wavelength of incident light is considered. B J

A78-52773 # Effect of temperature on the operational parameters of pCdTe-nCdS thin-film photocells (Vliianie temperatury na ekspluatatsionnye parametry plenochnykh pCdTe-nCdS-fotopreobrazovatelya) S A Azimov, Sh A Mirsagatov, D T Rasulov, and N Iunusov (Akademiya Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR) *Geliotekhnika*, no 4, 1978, p 30-32 In Russian

A78-52774 # Thermal detector of solar energy with selective coating and vacuum thermal-insulation (Teplopriemnik solnechnoi energii s selektivnym pokrytiem i vakuumnoi teploizolatsiei) G Ia Umarov, V S Trukhov, U Kh Gaziev, T Baimatov, T Z Abidov, and Iu E Kluchevskii (Akademiya Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR) *Geliotekhnika*, no 4, 1978, p 46-50 8 refs In Russian

The paper describes two design modifications of a solar-thermal-radiation detector with selective coating and screening vacuum insulation which operates reliably up to temperatures of 400 C. A method for calculating the operational characteristics of the detector is presented. Curves reflecting the dependence of thermal losses and efficiency on detector temperature for different modifications of the detector system and different solar energy densities are presented. B J

A78-52776 Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Conference sponsored by the Commission of the European Communities. Dordrecht, D Reidel Publishing Co., 1978 1378 p. In English, French, and German \$66 15

Recent developments and general aspects concerning silicon are considered along with the preparation of silicon material, polycrystalline silicon cells, the production of silicon cells from amorphous material, the fabrication of silicon concentrator solar cells, and silicon heterojunction cells. Attention is given to fundamental studies regarding photovoltaic devices, concentration devices, GaAs and similar cells, national activities and programs with respect to solar cells, CdS and similar cells, questions of module engineering, measurement problems, and systems and applications. G R

A78-52777 Introduction to the 1977 Photovoltaic Solar Energy Conference (Introduction à la Conférence de 1977 sur la Conversion Photovoltaïque de l'Énergie Solaire) R Chabbal and M Rodot (Centre National de la Recherche Scientifique, Paris, France) In *Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings* Dordrecht, D Reidel Publishing Co., 1978, p 29-50 In French

The paper reviews economic aspects and R&D aims in the photovoltaic conversion field. Particular attention is given to the short-term or medium-term aim of improving the technology of single-crystal silicon solar cells. Consideration is also given to the long-term aim of developing the second generation of solar cells: polycrystalline and amorphous silicon cells, GaAs cells, and cells based on CdTe and Cu₂S. Technical data on solar cells are presented. B J

A78-52778 Silicon solar cells from polycrystalline material H Fischer (Telefunken AG, Heilbronn, West Germany) In *Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings* Dordrecht, D Reidel Publishing Co., 1978, p 52-75 32 refs

This paper is intended to provide a review of the current status and the trends in the development of efficient low cost polycrystalline silicon solar cells. Theoretical estimates indicate that a reasonable conversion efficiency can be expected with this kind of cell, if both controlled size and structure of the grains can be achieved. Various methods producing polycrystalline silicon sheets are pursued: (a) films deposited by vacuum evaporation or CVD on non-silicon and MG-silicon substrates, (b) direct use of silicon as-cast as ingot or foil. As demonstrated recently, nonsingle crystalline solar cells have achieved promising characteristics. But considerable development and engineering efforts are still required for all processes to meet the long-range cost goals. (Author)

A78-52779 * New developments in silicon solar cells. J Lindmayer (Solarex Corp., Rockville, Md.) In *Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings* Dordrecht, D Reidel Publishing Co., 1978, p 76-91 9 refs. Contracts No JPL-954290, No F33615-76-C-2058

Three areas of silicon solar cell development are discussed. The first area relates to ultra thin cells about 50 microns in thickness, which can be made with relative good yield and efficiency. The second describes a new effort in vertical junction cells which show increased efficiency and continues to improve. The third area describes our semicrystalline silicon work which resulted in silicon solar cells that show over 10% terrestrial conversion efficiency and are tolerant to impurities. (Author)

A78-52780 Process to reduce the manufacturing cost of monocrystalline silicon solar cells H Lauvray and Y Salles (RTC La Radiotechnique-Compelec, Paris, France) In *Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings* Dordrecht, D Reidel Publishing Co., 1978, p 92-103

The paper discusses several production techniques whose implementation will lead to a reduction in the manufacturing costs of single-crystal silicon solar cells. These techniques include: (1) increasing the diameter of ingots, accompanied by an improvement in machining, (2) the use of large slices in a simple manufacturing range, which leads to improved efficiency and lifetime, and (3) the development of new encapsulation techniques. B J

A78-52781 High performance thin solar cell S Y Chiang, B G Carbajal, and G F Wakefield (Texas Instruments, Inc., Dallas, Tex.) In *Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings* Dordrecht, D Reidel Publishing Co., 1978, p 104-112 12 refs

A tandem junction cell (TJC) has been developed which has collecting junctions on both the illuminated and dark sides. The I-V photoresponse performance of the cell was measured for the case of collection from both sides and for the case of collection from the dark side only. Current collected from both sides of a 100-micron-thick cell was approximately 46 mA/sq cm, with the maximum expected at 30-50 microns. Current collected from the dark side only was 34 mA/sq cm for a 125-micron-thick cell, with 45 mA/sq cm expected for 30-50 microns. B J

A78-52782 Study of ion implanted n+/plus/ layers for silicon solar cells F Zignani (Bologna, Università, Bologna, Italy), F Cembali, R Galloni, L Pedullì, and M Servidori (CNR, Laboratorio LAMEL, Bologna, Italy) In *Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings* Dordrecht, D Reidel Publishing Co., 1978, p 113-124 13 refs. Consiglio Nazionale delle Ricerche Contract No 195,76,7,ESI

Phosphorus ions have been implanted - at energies of 100-150 keV at a constant dose of 2×10^{10} to 15 atm/sq cm - in silicon

single crystals. Experimental results are presented regarding isochronal recovery, charge carrier profiles, radiation damage, low temperature annealing, and solar cell volt-ampere characteristics. Particular attention is given to residual damage, responsible for the reduction of the lifetime of minority carriers in the n(plus) layer. The results have suggested the possibility of realizing a 'cold' solar cell by ion implantation. B J

A78-52784 Chemical vapour deposition of silicon on a liquid tin layer. M W M Graef, L J Giling, and J Bloem (Nijmegen, Katholieke Universiteit, Utrecht, Netherlands). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p 136-142

A78-52785 Recrystallization of CVD grown polycrystalline silicon. W J H Schins, J Bezemer, C Daey Ouwens, and S Radelaar (Utrecht, Rijksuniversiteit, Utrecht, Netherlands). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p 143-152. 6 refs. Research supported by the European Communities.

A78-52787 Continuous polycrystalline silicon layers on carbon substrates. C Belouet, J J Brissot, R Martres, and Mr Ngo Tich Phuoc (Laboratoires d'Electronique et de Physique Appliquée, Limeil-Brévannes, Val-de-Marne, France). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p 164-175. 15 refs. Research sponsored by the Commission of European Communities.

This article presents the early results of the study of the freezing of silicon films on carbon substrates by the ribbon against drop (RAD) pulling process in view of achieving low-cost solar cells for terrestrial applications. The main features relevant to this new deposition process are outlined, and the physical performances of the polycrystalline layers thus obtained are described. In particular, it is shown that the size of the columnar grains can be large (300 x 200 microns) and that encouraging conversion efficiencies above 6 percent (AM1 simulated illumination) have already been obtained on n(plus)/p diffused structures. (Author)

A78-52788 Polycrystalline silicon solar cells. E Fabre and Y Baudet (Laboratoires d'Electronique et de Physique Appliquée, Limeil-Brévannes, Val-de-Marne, France). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p 178-186. 14 refs. Research supported by the Délégation Générale à la Recherche Scientifique et Technique.

Solar cells have been made on polycrystalline silicon layers deposited onto a carbon substrate from the melt. Three different structures have been investigated for the collecting junction: the n(plus)/p diffused homojunction, the MIS barrier and the heterojunction with In₂O₃. A conversion efficiency of 62 percent is reported for a homojunction cell under AM1 simulated sunlight. Minority carrier diffusion length enhancement has been observed when the photon flux is increased on the cell. (Author)

A78-52789 Polycrystalline solar cells fabricated on metallurgical silicon substrates. T Warabisako, T Saitoh, H Itoh, N Nakamura, and T Tokuyama (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Tokyo, Japan). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p 187-196. 7 refs. Research supported by the Ministry of International Trade and Industry of Japan.

One way to reduce solar cell cost is the fabrication of a thin-film active layer on polycrystalline silicon substrate prepared from metallurgical-grade material. A cell of 8.3-sq cm area is found to exhibit an AM1 conversion efficiency of 7.3% when a 25-micron-

thick p-type active layer is grown on a CZ-pulled polycrystalline silicon wafer by a CVD process using SiH₂Cl₂, followed by the formation of a grown junction with a 0.54-micron thick n(plus)-layer. The photocurrent degradation due to grain boundaries was estimated to be less than 3% under light at a wavelength of 0.6 micron. B J

A78-52790 The limitations imposed by grain boundaries on the performance of epitaxially deposited polycrystalline silicon solar cells. G A van der Leeden, T L Chu, and C J Lin (Southern Methodist University, Dallas, Tex.). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p 197-206. 8 refs. Contract No. E(04-3)-1285.

A78-52791 Progress on aluminium p-type silicon SBSCs. W G Townsend and D R Lillington (Royal Military College of Science, Shrivenham, Wilts, England). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p 207-213.

A simple process is described for making aluminium p-type silicon SBSCs (Schottky barrier solar cells) on both single crystal and Wacker 'Silso' cast silicon substrates. The importance of the processing of the interfacial oxide layer in determining both cell efficiency and stability is stressed. Results of both electrical and optical properties of the cells are presented. These show that consistently high AM1 efficiencies of over 9 and 8% respectively may be achieved for single and cast silicon substrates and that the characteristics are stable over long periods of testing. The cells were all approximately 1 sq cm in area and coated with simple ZnS coatings. The high short circuit currents (approximately 22 mA/sq cm) obtained for the polycrystalline substrates indicate that grain boundary recombination is not a serious problem with these devices. (Author)

A78-52792 A model for amorphous silicon solar cells. B T Debney (Plessey Co., Ltd., Allen Clark Research Centre, Towcester, Northants, England). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p 216-222. 8 refs.

The paper shows that the photocurrent in amorphous silicon solar cell is determined by the photogeneration of carriers in the depletion region and their subsequent removal with the aid of the built-in field. This is confirmed by an analysis of the spectral response curve for a p-i-n device. The I-V characteristics for a model Schottky barrier solar cell under illumination are calculated. B J

A78-52795 Fabrication and measurement of silicon concentrator solar cells. J F Gibbons and F C Wu (Stanford University, Stanford, Calif.). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p 242-248.

Basic considerations relevant to the design of epitaxial silicon solar cells for concentrator applications are presented, including specific criteria for selecting the thickness of the epitaxial layer, the contact geometry, and the anti-reflection coating. Measurements made on cells fabricated according to the principles discussed show efficiencies at 20 suns of 16.5% at 30°C and 12.6% at 100°C. These values compare very favorably with theoretical expectations. The use of a continuous Ar laser for measurement of cell efficiency versus concentration is also described. (Author)

A78-52796 High intensity silicon solar cells. E Fabre (Laboratoires d'Electronique et de Physique Appliquée, Limeil-Brévannes, Val-de-Marne, France), L De Smet, and R Mertens (Leuven, Katholieke Universiteit, Heverlee, Belgium). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p 249-258. 7 refs. Research supported by the Commission des Communautés Européennes.

Optimization of 2×2 sq cm silicon solar cells for operation under medium range solar concentration has been carried out both theoretically and experimentally. A series resistance as low as 20 milliohms is shown to be necessary in order to keep the conversion efficiency above 12 percent for concentration ratios ranging between 20 and 50. Back surface field cells have been made with optimized top contact grid pattern on a 1 ohm cm base material. The influence of the diffused layer sheet resistance upon the series resistance and the photogenerated current has been investigated. A comparison between computed series resistance values and measured ones is presented. (Author)

A78-52797 Sunlight concentration for silicon rod solar cells. G. R. Johnson, M. G. Miles, D. P. Tanner (Monsanto Co., St. Louis, Mo.), and G. L. Ball, III (Monsanto Research Corp., Dayton, Ohio). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D. Reidel Publishing Co., 1978, p. 259-268, 7 refs.

Solar cell devices were made using diffused junctions on the surface of 4mm silicon rods together with non-tracking, 'ideal' trough concentrators. Two embodiments of the ideal concentrator design were studied: metallized opaque plastic forms and internally reflecting clear plastic castings. Combined solar cell/concentrator efficiencies of 10% were measured and efficiencies of 12% are projected. Small diameter silicon rod is considered as a high efficiency alternative to silicon ribbon for use in trough concentrators. (Author)

A78-52798 Double sided /DS/ solar cells to improve static concentration. A. Luque, J. M. Ruiz, A. Cuevas, J. Eguren, and M. G. Agost (Madrid, Universidad Politecnica, Madrid, Spain). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D. Reidel Publishing Co., 1978, p. 269-277, 7 refs.

Solar cells to be illuminated on both sides by placement in proper Winston mirrors have been developed to permit double static concentration gain for a given acceptance angle. Theory and experiments show that the product of open circuit voltage and short-circuit current is higher in double sided (DS) cells than in conventional or BSF cells. The DS cells have high series resistance which reduces the efficiency of experimental structures to 7 percent at two AM2 suns. A theoretical model of the DS structure series resistance is presented showing that, with proper metallization patterns, efficiencies of 11 percent at ten AM2 suns can be attained. (Author)

A78-52799 Improvement of the efficiency of silicon MIS-inversion layer solar cells. P. Van Halen, R. Mertens, R. Van Overstraeten, J. Van Meerbergen (Leuven, Katholieke Universiteit, Heverlee, Belgium), and R. E. Thomas (Carleton University, Ottawa, Canada). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D. Reidel Publishing Co., 1978, p. 280-288, 8 refs. Research supported by the Nationaal Fonds voor Wetenschappelijk Onderzoek.

Two new types of solar cells are described in which either a TiO_x or a SiO_2 layer is deposited onto p-silicon, contacts are obtained by means of a MIS tunnel-diode grid. It is shown that the TiO_x -MIS cells can be realized by single mask completely low temperature processing by employing spin-on of titanium-oxide antireflective coating. Conversion efficiencies of 8% at AM1 have been achieved with these cells, they perform even more efficiently at higher illumination levels. With the SiO_2 MIS cells efficiencies of 12% have been reached, at the expense of a more complicated process. A detailed comparison between the two cells is given. (Author)

A78-52800 Preparation and investigation of Sn doped Si/n-In2O3 heterojunction. J. C. Manificier, L. Szepeessy, and M. Savelli (Montpellier II, Universite, Montpellier, France). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D. Reidel Publishing Co., 1978, p. 289-298, 15 refs.

In2O3(n plus)-Si(n) heterojunction solar cells have been obtained, with the oxide prepared by closed space vapor transport (CSVT) on Si single crystals. A major feature of the Sn-doped In2O3 thin films is their excellent transparency (greater than 85 percent) over the complete useful window of the substrate spectrum. A conversion efficiency of 11 percent was obtained for 2-sq-cm cells with open circuit voltages of approximately 500 mV and short circuit currents of approximately 32 mA/sq cm, with a fill factor of 0.65. B. J.

A78-52801 The MIS and MISIM solar cell. M. A. Green and R. B. Godfrey (New South Wales, University, Kensington, Australia). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D. Reidel Publishing Co., 1978, p. 299-307, 10 refs. Research supported by the Australian Radio Research Board, Australian Research Grants Committee, and Sydney County Council.

The insertion of a very thin insulating layer (less than 20 Å) between the metal and the semiconductor of a Schottky solar cell can dramatically improve the open circuit voltage of the cell. The resulting MIS structure is shown to be electronically equivalent to a p-n junction device, provided that minority current flow is dominant. The MISIM solar cell, a new development, is also described, and it is shown that this structure is equivalent to the high-efficiency n(+)/pp(+) junction cell. B. J.

A78-52802 Schottky /MIS/ solar cells on ribbon silicon. A. E. Delahoy, W. A. Anderson, and J. K. Kim (Rutgers University, New Brunswick, N.J.). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D. Reidel Publishing Co., 1978, p. 308-318, 9 refs. Research supported by Rutgers University and NSF.

Schottky MIS cells have been fabricated on single crystal silicon with an open-circuit voltage of 0.60 V and an AM1 conversion efficiency of 12%. This paper investigates the ribbon silicon (from Mobil-Tyco and IBM) used as the substrate. It is found that the degree of perfection of Tyco and IBM ribbon may influence the open circuit voltage of the finished cell. It is apparent that surface-state effects can influence the open circuit voltage and that this influence may be modified by surface treatment of the silicon prior to the formation of the Schottky barrier. B. J.

A78-52804 Comparison between the efficiencies of MIS and SIS solar cell structures. P. De Visschere and H. Pauwels (Gent, Rijksuniversiteit, Ghent, Belgium). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D. Reidel Publishing Co., 1978, p. 330-339, 12 refs.

The paper analyzes the SIS solar cell structure, taking account of interface recombination and tunneling. Analytical results are

obtained and the efficiencies of various optimum structures are compared. It is found that the insulating layer is advantageous for heterojunction cells based on the collection of minority carriers excited in the weakly doped semiconductor, if the discontinuity in the energy band has the appropriate sign. The efficiency of the SIS cell can then be as high as that of a MIS or homojunction cell. B J

A78-52805 **A collection-velocity model for predicting efficiency of Schottky barrier solar cells.** P F Ordnung, A Adibi, D Heald, R Neville, and J Skalik (California, University, Santa Barbara, Calif.) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p. 340-349.

A minority-carrier collection-velocity model is derived and applied to the problem of predicting the collected photogenerated minority current in a Schottky barrier solar cell. The model establishes that the collected current can be viewed as two superimposed but unrelated components: the photogeneration in the depletion region and that in the neutral region. For collection purposes the neutral region is represented as a region in which the diffusion equation applies and which is bounded at each end by a specific velocity-collection model. The collection velocity model at the ohmic end is the standard surface-recombination model. At the Schottky barrier end a collection-velocity model equivalent to the depletion region of the device is employed. Short-circuit currents predicted by this model are found to compare favorably with those numerically obtained by Fossum for a 0.1-micron-junction n-p cell. (Author)

A78-52806 **New model of conduction mechanisms in disordered and amorphous photovoltaic devices.** B Pistoulet, J L Robert, J M Dusseau, F Roche, P Girard, and L Ensuque (Montpellier II, Université, Montpellier, France) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p. 350-358. 19 refs.

The paper develops a theoretical model which demonstrates the existence of medium range disorder: spatial fluctuations of impurity density - in amorphous and disordered semiconductors. These spatial fluctuations produce potential wells in which part of the carriers is localized when kT is smaller than the mean depth of the wells. The model can quantitatively explain the temperature dependence of drift mobility and conductivity of such semiconductors as amorphous silicon for use in solar cells. B J

A78-52807 **Design of a photovoltaic power-array with concentrated sunlight.** D Esteve, G Vialaret, K Achaïbou, and D Foillea (CNRS, Laboratoire d'Automatique et d'Analyse des Systèmes, Toulouse, France) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p. 360-369.

A design procedure for solar arrays with sunlight concentration is elaborated on the basis of a morphological analysis which defines materials and structural constraints associated with the costs of installation. The procedure was applied to the design of a 1 kW prototype array which uses silicon solar cells with concentration levels exceeding 50. The array consists of a flat panel mounted on a two-axes controlled tracking heliostat made of sealed rigid modules which protect the solar cells. B J

A78-52808 **A solar cell system for concentrated sunlight.** G Yekutieli, A Brandstetter, B Haber, R Joulzary, E Kritchman, and J Mandelkorn (Weizmann Institute of Science, Rehovot, Israel) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p. 370-376.

A test and evaluation facility for high-concentration solar cells and optical concentrators was constructed including a two-axis sun tracker and measuring instruments interfaced with a small computer. Silicon solar cells, Fresnel lenses, concentrating mirrors, and other elements of the system were evaluated in the facility. Using the

results of the study, a silicon solar cell and a Fresnel lens were chosen for a prototype solar cell system, designed to operate at 100 suns with approximately 10% efficiency. B J

A78-52809 **The solar eyeball - A self-powered self-steering photovoltaic generator.** D H Mash and P W Ross (Standard Telecommunication Laboratories, Ltd., Harlow, Essex, England) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p. 377-385.

A description is presented of a solar-electric conversion module which uses a plastic Fresnel lens to concentrate sunlight onto a group of GaAs/GaAlAs solar cells. These cells have yielded 16-20% conversion efficiency and are expected to maintain this level at high intensities and temperatures involved. The ability to track the sun is achieved using a novel pneumatic system powered by solar energy. When the 'eyeball' is misaligned, the sun's image falls on a heat exchanger in one of the two air-reservoirs adjacent to the cells. The resulting expansion forces a magnetized piston against a fixed external magnetic field, causing the complete module to rotate until the solar cells are again in focus. B J

A78-52810 **Metal alkyl grown GaAs solar cells.** E Fabre, A Brière, and J P Andre (Laboratoires d'Electronique et de Physique Appliquée, Limeil-Brevannes, Val-de-Marne, France) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p. 388-394. 12 refs. Research supported by the Délégation Générale à la Recherche Scientifique et Technique.

Gallium arsenide solar cells have been made using the metal-alkyl growth technique. A p-n homojunction within the GaAs is covered by a p-GaAlAs window layer in order to decrease the surface recombination velocity down to values as low as a few 1000 cm/s. The AM1 efficiency is close to 16 percent with the following characteristics: open-circuit voltage equals 895 mV, short circuit current equals 24 mA/sq cm, FF equals 0.74. (Author)

A78-52811 **Gallium arsenide solar cells for use with concentrated sunlight.** J W Burgess, R Davis, B T Debney, and R Nicklin (Plessey Co., Ltd., Allen Clark Research Centre, Towcester, Northants, England) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p. 395-404. 12 refs. Research supported by the Commission of the European Communities.

Standard theoretical modeling techniques have been used to compare the performances of GaAs/Ga(1-x)Al(x)As solar cells with graded band gap and 'window' structures. It is shown that graded band gap structures can give a solar cell performance superior to the standard heterojunction cell when operating at high concentration ratios. The graded structures can be conveniently prepared by the metallo-organic chemical vapor deposition (MOCVD) process. A VPE reactor has been constructed for the preparation of large area devices. B J

A78-52812 **Preparation of Ga_{1-x}Al_xSb p-n homojunctions and study of the photovoltaic effect (Préparation d'homojonctions p-n à Ga_{1-x}Al_xSb et étude de l'effet photovoltaïque).** A Nguyen Van Mau, G Bougnot, H Y Muoy, and G M Moussalli (Montpellier II, Université, Montpellier, France) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p. 405-414. 15 refs. In French.

Ga(1-x)Al(x)Sb layers have been obtained by vertical liquid-phase epitaxy. The junctions were prepared on tellurium-doped GaSb substrates. As a result, Ga_{1-x}Al_xSb(p)-Ga_{1-x}Al_x(n)-GaSb(n) structures were formed with junction depths of 5.20 microns, with x between 0.0 and 0.75. The dark I-V and C-V characteristics of the structure are presented and its photovoltaic characteristics are investigated. B J

A78-52813 Stabilization of the GaP/electrolyte photo-voltaic cell M J Madou, W P Gomes, and F Cardon (Gent, Rijksuniversiteit, Ghent, Belgium) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co, 1978, p 415-424 7 refs

Experimental results are presented on GaP/electrolyte solar cells. Flat-band potential, open circuit voltage, and dark open circuit voltage were measured as a function of pH (sulfate medium) for n-type GaP. Photocurrent was measured as a function of applied voltage and of time for n-GaP and anodic current density was measured as a function of pH. Open circuit photovoltage and dark rest potential are presented for different electrolyte compositions. It is shown that the Fe/CN_6^{4-} ion captures holes from the GaP anode, and that this competing hole reaction can prevent the anodic dissolution of the electrode, leading to the stabilization of the latter.

B J

A78-52814 Semiconductor-electrolyte solar cells - A new rechargeable redox solar battery W Gissler (Commission of the European Communities, Joint Research Centre, Ispra, Italy) and R Memming (Philips Forschungslaboratorium Hamburg GmbH, Hamburg, West Germany) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings

Dordrecht, D Reidel Publishing Co, 1978, p 425-435 31 refs

Semiconductor electrolyte electrodes can be used for solar energy conversion into electric and storable chemical energy. The working mechanism of regenerative and water photoelectrolysis cells is described and discussed. A new semiconductor-electrolyte cell is proposed in which solar energy is transformed into storable chemical energy using two different redox systems as in a rechargeable redox battery. First experimental results are reported. (Author)

A78-52815 A novel electrochemical solar cell J R Owen and W A Gerrard (Arya Mehr University of Technology, Teheran, Iran) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co, 1978, p 436-444 7 refs

A new low-temperature method for the preparation of cadmium selenide photoanodes is described. The method involves the electroplating of cadmium onto a steel plate and the subsequent conversion of cadmium to its selenide by corrosion in a hot solution of selenium in 5M KOH solution. Upon immersion of this photoanode into a sodium sulfide/polysulfide solution together with a suitable counter-electrode, a solar cell can be produced which has shown conversion efficiencies up to 1.7%.

B J

A78-52816 The photovoltaic project of the Commission of the European Communities W Palz (Commission of the European Communities, Brussels, Belgium) and R van Overstraeten (Leuven, Katholieke Universiteit, Heverlee, Belgium) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co, 1978, p 446-452

Attention is given to the first phase of the European Communities photovoltaic project. This phase includes studies on the improvement of solar cells, feasibility studies on new concepts and alternative cells, techniques for the fabrication of thin silicon and CdS sheets, the utilization of concentrators, and encapsulation and interconnection problems. Some of the aims of the second phase of the project are also discussed, including the improvement and automation of existing technology, and the development of prototype cells and plants.

B J

A78-52817 Current status of the US terrestrial photovoltaic conversion program L M Magid (US Department of Energy, Div of Solar Energy, Washington, D C) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co, 1978, p 453-465

The United States Energy Research and Development Administration (ERDA) is currently restructuring the Photovoltaic Program within the Division of Solar Energy. The desire is to (1) reorient the program to near-term goals and accomplishments, (2) increase the involvement of industry in the identification and selection of the right technology, experiments and systems, and (3) increase the activity in breakthrough (high-risk) research. The key assumption in undertaking this reorientation is that the market will enter an explosive self-sustaining growth phase at an array price of \$1 to \$2 per peak watt by 1980. The current status of the draft program being planned to achieve these objectives will be reviewed. (Author)

A78-52818 Photovoltaic conversion - French research and development activities (La conversion photovoltaïque - Activités françaises de recherche et développement) M Rodot and M Clavier (CNRS, Paris, France) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co, 1978, p 466-479 In French

The current status of the French photovoltaic conversion program is reviewed. Consideration is given to such technological developments as evaluations of photovoltaic systems and concentration systems, the development of amorphous silicon, and the characterization of thin polycrystalline silicon layers. Some results of research and development are discussed, including solar cells and panels manufactured by RTC, the realization of silicon contacts and junctions, cadmium telluride solar cells, layered semiconductor crystals, and solar pumps.

B J

A78-52819 Solar cell programme for India In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co, 1978, p 480-492

Technical and economic factors associated with the development of solar-cell energy in India are discussed. Emphasis is placed on the use of solar cells in rural areas for purposes of water pumping for drinking and irrigation, and rural home electrification. Government policy with respect to the solar cell program is reviewed, and attention is given to projects undertaken under the aegis of this program, including conventional and high-concentration silicon solar cells, low-cost techniques, and GaAs, MIS, and heterojunction cells.

B J

A78-52820 Status of the West German terrestrial photovoltaic program H R Losch (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Bereich für Projekttragerschaften, Cologne, West Germany) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings

Dordrecht, D Reidel Publishing Co, 1978, p 493-500 23 refs

This paper gives a summary of the different activities on terrestrial photovoltaic developments in West Germany. Scientific details on most of the work performed can be found in several papers of this conference and in the numerous references listed. The overall objective is to develop low-cost reliable photovoltaic systems. Research, development and demonstration tests on photovoltaic systems were conducted. The work on silicon cells has been emphasized and led to novel, very promising cells made of polysilicon. Novel materials have been investigated to find out their feasibility of low-cost cells. A long time program is under discussion, but has not yet been approved. (Author)

A78-52821 Photovoltaics activity in Mexico E J Perez (Instituto Politecnico Nacional, Mexico City, Mexico) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co, 1978, p 501-510

The paper presents the historical background of the development of photovoltaic conversion in Mexico. Particular consideration is given to the development of photovoltaics at the Electrical Engineering and Physics Departments of the Study Center of the National Polytechnical University, and at the Materials Study Center at the National University. Economic factors are also considered. B J

A78-52822 Italian activities in the field of photovoltaic conversion S Pizzini (Montedison S.p.A., Novara, Italy) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 511-514

A description of the major research activities in the field of photovoltaic conversion in Italy is given. Emphasis is placed on the structure of the national research program and the selection of the objectives, which assign a leading role to the conversion devices under concentrated sunlight (Author)

A78-52823 Photovoltaic system in 'Sunshine Project' national R & D program in Japan T Koyanagi (Ministry of International Trade and Industry, Electrotechnical Laboratory, Tokyo, Japan) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 515-521

The purpose of R&D for the photovoltaic system in the Sunshine Project is to reduce the cost of the conversion system for terrestrial use by a factor of 100. This R&D is discussed with reference to silicon ribbon crystals, silicon thin film solar cells, new types of solar cells and arrays, solar cells using II-VI compound semiconductors, and fundamental research on solar cells. (Author)

A78-52824 Photovoltaic activities in the United Kingdom A A Dollery (Royal Aircraft Establishment, Farnborough, Hants., England) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 522-531

Research and development aimed at reducing the cost and increasing the efficiency of solar cells, modules, arrays, and systems in the United Kingdom is reviewed. The cell types involved include crystalline and amorphous silicon, thin film and ceramic cadmium sulfide, cadmium sulfide/indium phosphide, gallium arsenide and Schottky barrier. Summary tables of these activities are provided.

B J

A78-52825 Progress in the development of high efficiency thin film cadmium sulfide solar cells A M Barnett, J D Meakin, A Rothwarf (Delaware, University, Newark, Del.) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 535-546. 14 refs. NSF Grant No. AER-72-03478, Contract No. E(49-18)-2538

Thin film cadmium sulfide/copper sulfide solar cells have been developed and optimized for specific cell designs. The application of analytic techniques to specific cell designs is responsible for the improvements achieved to date, and it is expected to lead to a basic cadmium sulfide/copper sulfide cell with an efficiency exceeding 10%. It is also expected that the application of similar analytic techniques to a modified cell of cadmium-zinc sulfide/copper sulfide will lead to a conversion efficiency in direct sunlight of up to 14%.

B J

A78-52826 CdS-Cu₂S thin film solar cells for terrestrial applications. W. Arndt, G. Bilger, W. H. Bloss, G. H. Hewig, F. Pfisterer, and H. W. Schock (Stuttgart, Universität, Stuttgart, West Germany) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 547-556. Bundesministerium für Forschung und Technologie Contract No. ET-4045.

CdS-Cu₂S thin film solar cells of size 7 x 7 sq cm have been investigated to optimize the processes of technology and to provide large scale terrestrial applications economically. The fabrication process of 30 micron CdS layer and 0.3 micron Cu₂S layer, the connection and integration of discrete cells in panels and the method of encapsulation are described. A series of accelerated tests of optimized front contact materials, with degradation due to irradiation and thermal cycling have been performed and field tests for a period of about one year of operation are reported. (Author)

A78-52827 On optimization of performance of a Cu₂S-CdS heterojunction solar cell through heat treatment S Deb (Jadavpur University, Calcutta, India) and H Saha (Chloride India, Ltd., Calcutta, India) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 557-569. 10 refs.

A78-52828 Behaviour of deep centers in Cu₂S/CdS solar cells. J. Bernard and J. P. Vormus (Toulouse, Centre d'Études et de Recherches, Toulouse, France) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 570-580. 16 refs. Délégation Générale à la Recherche Scientifique et Technique Contract No. 76-7-1487.

Results of photocapacitance studies of Cu₂S/CdS solar cells are presented. The deep centers of the cells were excited by monochromatic radiation at 0.4 and 1.1 micron in the 77-300 K temperature range. Particular consideration is given to the relaxation of optically excited deep centers. A phenomenological model is used to characterize the photovoltaic mechanisms observed in this heterostructure. The model takes account of tunneling in the photocurrent, thermal and optical cross sections of the deep centers, and photocarrier injection levels. B J

A78-52831 Spray preparation of cuprous sulfide layers J. Vedel, M. Soubeyrand, P. Cowache, and G. Leduc (Ecole Nationale Supérieure de Chimie, Paris, France) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 601-607. 9 refs.

It is shown that CuCl-thiourea complexes may be prepared using acetonitrile as a solvent. The process thus avoids the side reactions produced when water is used as the solvent. The preparation is discussed noting comparative physical and chemical properties of both acetonitrile and water. Thermal decomposition is evaluated by a thermogravimetric analysis and the final products are identified by X-ray diffraction analysis. S C S

A78-52832 II-VI compound solar energy converters A. L. Fahrenbruch, J. Aranovich, F. Courrages, S. Y. Yin, and R. H. Bube (Stanford University, Stanford, Calif.) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 608-617. 10 refs. ERDA-supported research.

Consideration is given to the design and performance of II-VI compound heterojunction solar converters which use p-CdTe as the absorber layers. It is shown that cells based on a p-CdTe absorber with CdS, ZnCdS, ITO, or ZnO windows offer efficiencies of at least 8%. Values are presented for a series of p-CdTe-based heterojunctions noting window bandgap, open-circuit voltage, and solar efficiency measured in simulated and natural sunlight. The photovoltaic properties of metal-oxide/CdTe junctions are discussed. S C S

A78-52836 Zn₃P₂ as a photovoltaic material A. Catalano, V. Dalal, E. A. Fagen, R. B. Hall, J. V. Masi, J. D. Meakin, G. Warfield, and A. M. Barnett (Delaware, University, Newark, Del.) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 644-653. 7 refs. Contract No. E(49-18) 2460.

An examination is made of Zn₃P₂ as developed for low-cost, high-efficiency photovoltaic cells. Material preparation is outlined noting that single crystals up to 1 x 2 cm have been grown by vapor transport using the Bridgman technique. Consideration is given to defect chemistry with reference to electrical resistivity measured by the four point probe method, the influence of annealing, and hole concentration as a function of phosphorous equilibrium partial pressure. Based on X-ray diffraction analysis, the degree of preferential orientation was determined. Optical properties are outlined in terms of the interband absorption edge of Zn₃P₂ bulk monocrystals.

and room-temperature reflectivity. Consideration is given to the development of Zn₃P₂ photovoltaic cells and values are presented for the dark current-voltage characteristics of Mg Schottky contacts to single crystal Zn₃P₂. SCS

A78-52837 * **Real-time and accelerated outdoor endurance testing of solar cells** A F Forestieri and E Anagnostou (NASA, Lewis Research Center, Cleveland, Ohio) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 656-676 6 refs ERDA-supported research

Materials for solar-cell module construction have been studied on the basis of limited real-time outdoor exposure evaluations. The materials tested included transmission samples, sub-modules, and actual solar cells. The results suggest that glass, fluorinated ethylene propylene, and perfluoroalkoxy are good materials for the covering or encapsulation of solar-cell modules. In all cases, dirt accumulation and cleanliness are important factors. SCS

A78-52838 **Terrestrial solar array experiments performed by Space Department, RAE Farnborough** M W Walkden and A A Dollery (Royal Aircraft Establishment, Farnborough, Hants, England) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 677-684

Various studies of solar cells and arrays designed for terrestrial applications are reviewed. A study in Malta aimed at measuring array degradation, evaluating panel performance, and gathering insolation data is considered. A flashing xenon lamp navigation system is described. A radio navigation beacon system is discussed noting the power supplied by the solar array and auxiliary batteries. SCS

A78-52841 **Environmental and endurance tests for space application of low cost solar cells made of terrestrial silicon base material** H Bebermeier (Telefunken AG, Wedel, West Germany) and J C Larue (ESA, European Space Research and Technology Centre, Noordwijk, Netherlands) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 710-719

In 1975 AEG-Telefunken began a research and development program in the field of terrestrial solar arrays. A non-single crystalline silicon base material has been introduced. This paper describes space environmental and endurance tests which have been performed with 2 x 2 and 5 x 5 sq cm terrestrial solar cells partly by AEG-Telefunken and partly by ESTEC. The tests show that non single crystalline solar cells (N SCS) developed for terrestrial application survive the environmental conditions for space application. (Author)

A78-52843 **Terrestrial photovoltaic performance measurement** F C Treble In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 732-744 8 refs

Procedures for measuring the performance of terrestrial photovoltaic cells are presented. Possible standards for rating solar spectral energy distribution and for selecting 28°C as a standard temperature for performance rating are noted. Procedures for measurements in natural and simulated (steady-state or pulsed) sunlight are given. The selection of cells for calibration as standards is described noting the NIP (Normal Incidence Pyrheliometer) and global methods. The development of solar simulators is considered in terms of total irradiance, spectral match, uniformity, temporal stability, and beam subtense angle. Instrumentation is briefly reviewed. SCS

A78-52844 * **U.S. terrestrial solar cell calibration and measurement procedures** H W Brandhorst, Jr (NASA, Lewis Research Center, Cleveland, Ohio) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 745-753 10 refs ERDA-supported research

An outline is presented of changes in measurement procedures concerning solar cells. Outdoor measurements of cell performance based on pyranometer or pyrheliometer determination of intensity are discouraged. The absolute scale of irradiance is to be adopted as soon as possible. The standard atmosphere conditions are 1000 W/sq m irradiance, temperature 28°C, air mass 1.5, and precipitable water vapor content of 2 cm. The allowable light sources for solar simulation are short arc xenon lamps, pulsed xenon lamps, and dichroic filtered tungsten lamps. Key considerations in the design of a reference cell are considered and approaches for the matching of a reference cell to a test cell or modules are discussed. GR

A78-52846 **A pumping station powered by a photovoltaic converter in the Sahel (Une station de pompage alimentée par générateur photovoltaïque au Sahel)** B Keita, M Cadene, G W Cohen-Solal, and P Chartier (Dakar, Université, Dakar, Senegal) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 770-778 8 refs In French

A water pumping station powered by photovoltaic converter is studied. The efficiency and reliability are analyzed. The effect of external parameters, solar declination, dust, temperature is studied. A more powerful station is proposed according to the experimental results. (Author)

A78-52847 **Optimization of a pumping station powered by a photovoltaic converter (Optimisation d'une station de pompage alimentée par générateur photovoltaïque)** M Barlaud and C Masselot (Dakar, Ecole Nationale Supérieure Universitaire de Technologie, Dakar, Senegal) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 779-789 In French

The reported investigation has the objective to determine optimum operating conditions for a pumping station which is powered by a photovoltaic converter. It is found that an operation of the photovoltaic converter at constant voltage is required to obtain maximum power. In the investigation the voltage was automatically adjusted with the aid of a servochopper. Under the considered conditions, the motor which drives the water pump consumes a constant current at a variable voltage. The hydraulic energy obtained was more than twice the amount of energy obtained under comparable conditions in the case in which the photovoltaic converter was directly connected to the motor. GR

A78-52848 **Field tests of photovoltaic power systems.** M D Pope and R W Martin (MIT, Lexington, Mass.) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 790-800 6 refs

The reported field tests were conducted to establish the technical credibility of solar photovoltaic (PV) energy systems and to identify and eliminate technical and institutional constraints to their widespread acceptance. The first step towards the realization of large scale agricultural systems utilizing photovoltaics was made during the summer of 1977 in connection with the construction and operation of a subscale experimental unit generating approximately 25 kW peak power. The photovoltaic array was used to drive a 7.5 kW pump that is interconnected with an automatic gated pipe irrigation system and a reservoir of 2500 cubic meter capacity. Attention is also given to photovoltaic applications in the U.S. National Park Service and photovoltaic power for a lighting system at a Chicago museum. GR

A78-52849 **New energies in telecommunications (Les énergies nouvelles dans les télécommunications).** R Colin In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 801-808 In French

A description is presented of a power station which was designed to supply electric energy to radio relays in remote locations. The station contains a solar battery and a wind-driven generator connected in parallel. A storage battery ensures continuity and regularity of output power. Power in the range from 100 to 400 watts can be supplied. Power supplies for devices installed along

highways for making emergency calls are also considered. Difficulties which arise in particular in developing countries with respect to the supply of batteries in the case of battery-operated devices, can be eliminated by making use of solar cells G R

A78-52850 Putting to use solar energy with silicon photovoltaic cells G J Naaijer (Laboratoires d'Electronique et de Physique Appliquée, Limeil-Brevannes, Val-de-Marne, France) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 809-816

An approximately constant output voltage is required for an operation of photovoltaic cells or modules under optimum power transfer conditions. For most applications, the best approach for obtaining the desired operational conditions involves the employment of secondary batteries as an interface. This approach provides the constant voltage output characteristics needed and, in addition, makes day and night operation possible. A further advantage of such a buffer battery is related to the capability of the battery to deliver to the load an instantaneous power which can be much higher than the maximum photovoltaic generator output. Attention is given to a use of photovoltaic cells with a battery for pumping water, the employment of an adaptive switching system, a case in which a constant output current was needed, and approaches for decreasing the battery capacity which is needed G R

A78-52851 * The ERDA/LeRC Photovoltaic Systems Test Facility A F Forestieri (NASA, Lewis Research Center, Cleveland, Ohio) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 817-824 5 refs ERDA supported research

The ERDA/LeRC Photovoltaic Systems Test Facility (STF) provides a vital support function to the overall ERDA National Solar Photovoltaic Program. It allows preliminary investigation and check out of components, subsystems, and complete photovoltaic systems before installation in actual service. The STF can also be used to determine optimum system configurations and operating modes. A facility description is presented, taking into account the solar cell array, the energy storage equipment, the power conditioning equipment, electric utility distribution network and loads, and instrumentation and data acquisition systems. Safety procedures which have been set up for maintenance and inspection of the solar array are discussed. Attention is also given to a number of investigations regarding the effect of environmental factors on solar cell array operation G R

A78-52852 The solar breeder J Lindmayer (Solarex Corp., Rockville, Md.) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 825-835 5 refs

It was pointed out that a photovoltaic panel manufacturing plant can be made energy-independent by using energy derived from its own roof using its own panels. Such a plant becomes not only energy self-sufficient but a major supplier of new energy, hence the name solar breeder. The reported investigation establishes certain mathematical relationships for the solar breeder which clearly indicate that a vast amount of net energy is available from such a plant for the indefinite future. It is pointed out that if solar electric plants would be built according to the solar breeder principle, their operation as a net energy source would be automatically assured G R

A78-52853 * Candidate solar cell materials for photovoltaic conversion in a solar power satellite /SPS/ P E Glaser and D W Almgren (Arthur D Little, Inc., Cambridge, Mass.) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 836-845 7 refs Contract No. NAS9-15294

In recognition of the obstacles to solar-generated baseload power on earth, proposals have been made to locate solar power satellites in geosynchronous earth orbit (GEO), where solar energy

would be available 24 hours a day during most of the time of the year. In an SPS, the electricity produced by solar energy conversion will be fed to microwave generators forming part of a planar phase-array transmitting antenna. The antenna is designed to precisely direct a microwave beam of very low intensity to one or more receiving antennas at desired locations on earth. At the receiving antenna, the microwave energy will be safely and efficiently reconverted to electricity and then be transmitted to consumers. An SPS system will include a number of satellites in GEO. Attention is given to the photovoltaic option for solar energy conversion in GEO, solar cell requirements, the availability of materials, the implication of large production volumes, requirements for high-volume manufacture of solar cell arrays, and the effects of concentration ratio on solar cell array area G R

A78-52854 Solarelectric power supply for a television transmitter in Western Germany H K Kothe (VARTA Batterie AG, Kelkheim, West Germany) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 846-850

In order to reduce the costs of the installation for small television transmitters the broadcasting company 'Sudwestfunk' performs a five years service test with a solar powered 25 Watt transmitter in the mountains of the Eifel. The layout involved the problem of minimizing the costs of solar generator and battery and having sufficient safety for continuous supply in spite of the considerable annual variations in solar energy. The method for solving this problem developed by the author is described (Author)

A78-52862 Indium tin oxide/silicon solar cells J R Sites and J B DuBow (Colorado State University, Fort Collins, Colo.) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 930-936 8 refs Contract No. E(04-3)-1203

Twelve percent efficient solar cells consisting of indium tin oxide on single crystal silicon have been fabricated and characterized. Study of the interface indicates the existence of a silicon dioxide layer. A theoretical model which fits experimental observations is that of a tunnel semiconductor-insulator-semiconductor diode. Detailed electrical measurements indicate that the solar cell performance approximates that of diffused p-n junction solar cells. Economic models and studies of indium supply indicate that an economically viable ITO terrestrial photovoltaic conversion technology is possible (Author)

A78-52865 Silicon double solar cell I Chambouleyron and Y Chevalier In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 967-976 10 refs Research supported by the Organization of American States

The silicon double cell consists of a p-type material sandwiched between two identical n(+)-type diffused regions. The cell is analyzed for two different irradiation conditions: (1) irradiation of one of the diffused surfaces, and (2) irradiation of both sides of the cell. The various mechanisms involved in the photoresponse are discussed, and design criteria for the double cell are analyzed as a function of material characteristics B J

A78-52866 Getting more power out of silicon. Y Chevalier and I Chambouleyron In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co., 1978, p 977-986 Research supported by the Organization of American States

A study was conducted to investigate the possibility of obtaining more power from silicon solar cell wafers without increasing the complexity of cell manufacturing. Two such possibilities were studied: (1) the simultaneous illumination of both faces of a classical cell, and (2) the use of twin cells. A nonconventional solar

cell has been investigated which may yield twice the power obtained from a conventional cell on the same silicon wafer B J

A78-52867 **Solar cell sheet resistance analysis** I Cham-bouleyron In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co, 1978, p 987-995 Research supported by the Organization of American States

In this paper a theoretical analysis is carried out on the influence of collecting grid patterns in solar cell sheet resistance Several conventional grids are studied in different cell geometries Numerical calculations are presented as well as expressions giving the sheet resistance as a function of collecting finger density and diffused layer characteristics A graphical representation of the results is given in a single figure which allows a rapid determination of the appropriate geometry and the finger density corresponding to a specified sheet resistance These results are compared with previous calculations

(Author)

A78-52868 **Thermal modeling of solar cells operating under concentrated sunlight** B Hachem (Liège, Université, Liège, Belgium) and R Mertens (Leuven, Katholieke Universiteit, Louvain, Belgium) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co, 1978, p 996-1003 10 refs Research supported by the Nationaal Fonds voor Wetenschappelijk Onderzoek

The paper develops a rather rigorous model to calculate the temperature field in a photovoltaic system, operating under concentrated sunlight General equations describing energy conservation in the cell and governing its temperature field are obtained The equations depend on effective concentration, efficiency, and the optical, thermal, and geometrical properties of the cell The model is applied to two particular systems those with passive fin-cooling and those with active cooling B J

A78-52869 **Non-linear analysis of solar-cells-series resistance** S Bobbio, F P Califano (Napoli, Università, Naples, Italy), and E Ciccione (Olivetti Controllo Numerico S p A, San Bernardo d'Ivrea, Italy) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co, 1978, p 1006-1018 Research supported by the Consiglio Nazionale delle Ricerche

Both one- and two-dimensional models are used in a nonlinear analysis of the series resistance of solar cells Consideration is also given to the effects of series resistance on the fill factor and on the equivalent circuit of the cell The results are used to examine a variety of cases illustrating the behavior of solar cells at high levels of illumination It is found that an overly high finger-spacing reduces cell performance B J

A78-52870 **On the improvement of Schottky solar cells** A H M Shousha (Cairo University, Cairo, Egypt) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co, 1978, p 1019-1026 8 refs

Simplified expressions which relate conversion efficiency to cell parameters are derived for Schottky barrier solar cells Barrier height and the q-factor are studied as a function of cell parameters It is shown that increasing the potential barrier height increases the open circuit voltage as well as the fill factor, on the other hand, increasing the q-factor increases the open circuit voltage, but has no appreciable effect on the fill factor B J

A78-52871 **Transition region recombination in solar cells** J R Mallinson and P T Landsberg (Southampton, University, Southampton, England) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co, 1978, p 1027-1032 7 refs

The paper develops a theoretical model which shows that the effect of recombination current density in the transition region is significant in a typical silicon n-on-p homojunction solar cell This

effect appears to become less important with increasing concentration of solar radiation for concentration values in the range 1-100 The present theory becomes less reliable for larger concentration values Shockley-Read type recombination tends to predominate over Auger effects and band-band recombination B J

A78-52872 **Indirect gap semiconductors for photovoltaic solar energy conversion** C Vérie, M Leroux (CNRS, Laboratoire de Physique du Solide, Meudon, Hauts-de-Seine, France), A Tromson, and P Gibart (CNRS, Laboratoire de Magnétisme, Meudon, Hauts-de-Seine, France) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co, 1978, p 1033-1043 15 refs Delegation Generale a la Recherche Scientifique et Technique Contract No 76-7-1500

The paper considers the possibility of utilizing the direct-indirect gap transition of certain ternary III A-V A alloys for the purpose of high-efficiency photovoltaic solar energy conversion The importance of the $Al(1-x)In(x)Sb$ and $Al(1-x)In(x)As$ alloys in this connection is discussed The thermodynamics of the chemical vapor deposition of these two types of alloys is examined in detail B J

A78-52874 **SARA - Concentration solar array with reflector-radiations** W D Ebeling, D Rex (Braunschweig, Technische Hochschule, Braunschweig, West Germany), J Gulpen, and E. Hornung (ERNO - Raumfahrttechnik GmbH, Bremen, West Germany) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co, 1978, p 1056-1070

The feasibility of a new design for space solar generators is investigated, which uses cylinder-parabolic reflector-radiators to concentrate solar radiation on to solar cells and to radiate the thermal energy off the solar cells The reflector-radiators are thermally optimized and their mechanical stability is investigated A carbon fiber reinforced plastic (CFRP) frame which holds the CFRP reflectors is designed The calculations show that this panel has a mass to power ratio lower than any known nonconcentrating light weight panel and that only one third of the solar cells is needed Technological results on manufacturing of thin parabolic CFRP reflectors, application of specular surfaces and CFRP thermal conductivity are reported (Author)

A78-52875 **Linear Fresnel lenses and their use in photovoltaic generators** B Hachem (Liège, Université, Liège, Belgium) and R Mertens (Leuven, Katholieke Universiteit, Louvain, Belgium) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co, 1978, p 1071-1079 9 refs Research supported by the Nationaal Fonds voor Wetenschappelijk Onderzoek

An analytical method is proposed for computed-assisted calculation of the collection efficiency of concentrator systems based on linear Fresnel lenses and operating in a quasi-static mode The method allows calculation of the collection efficiency throughout the year for all orientations (as long as the axis is east-west oriented) and all locations Attention is given to the analytical simulation of a system consisting of a linear Fresnel lens mounted on a V trough, thereby reducing the necessary cell area and causing a more uniform illumination of the cells S D

A78-52879 **The influence of the composition of the solution on GaAs-electrolyte photovoltaic cell characteristics** R L Van Meirhaeghe, F Cardon, and W P Gomes (Gent, Rijksuniversiteit, Ghent, Belgium) In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings Dordrecht, D Reidel Publishing Co, 1978, p 1109-1118 9 refs

A78-52881 **Dry barrier formation of Cu₂S-CdS junctions** A N Casper and R Hill (Newcastle-upon-Tyne Polytechnic, Newcastle-upon-Tyne, England) In Photovoltaic Solar Energy Con-

ference, Luxembourg, September 27-30, 1977, Proceedings
Dordrecht, D Reidel Publishing Co., 1978, p
1131-1140 12 refs

Chemical and physical processes that take place during dry-barrier formation of a Cu₂S-CdS junction are studied. Emphasis is placed on preparation techniques which bring about a significant improvement in the power conversion efficiency of the solar cell produced. The thickness of the Cu₂S layer is about equal to the theoretical optimum when a silver back-surface contact is used. Improvements in efficiency are expected when silver-coated glass is used as the substrate in place of molybdenum. Further improvements in efficiency might result if the cells were encapsulated, because of improved optical matching and reductions in the outer surface recombination rate. S D

A78-52885 Cuprous oxide as a photovoltaic converter. C Noguet, M Tapiero, C Schwab, J P Zielinger (Strasbourg I, Université, Strasbourg, France), D Trivich, R J Komp, E Y Wang, and K Weng (Wayne State University, Detroit, Mich). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p 1170-1179 10 refs

Cuprous oxide is an attractive material for large scale use in photovoltaic cells for terrestrial solar energy conversion because of a series of characteristics. Semi-empirical calculations indicate that a conversion efficiency of up to 12 percent is possible in principle, nevertheless the practical conversion is still limited to approximately 1 percent whatever the methods developed for making the junctions. Therefore a study of the physical parameters of importance such as barrier height, diffusion length of minority carrier and spectral response has been undertaken on several types of junctions. (Author)

A78-52887 A new approach for developing solar photovoltaic cells (Nouvelle approche de réalisation de cellules photovoltaïques solaires). X Gerbaux, A Hadni, and R Thomas (Nancy I, Université, Nancy, France). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p 1186-1191 6 refs. In French

The study demonstrates the effectiveness of the method of epitaxial growth in submicroscopic holes (EGSH) in obtaining thin single crystal films deposited by evaporation of triglycine sulfate (liquid and vapor phases). The EGSH method is used to fabricate a quasi-single-crystal film of tellurium having a thickness of 3.15 microns and an area of 5 x 8 sq mm. The single-crystal state is assessed by observation of IR birefringence. Striking advantages of the EGSH method are low-cost production of evaporated films and high photoelectric efficiency of single crystals. S D

A78-52889 * Method for minimizing the cost/Watt of complete photovoltaic systems and applications. D Redfield (RCA Laboratories, Princeton, N.J.). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p 1202-1210 ERDA-NASA-sponsored research

The paper describes an optimization method and some applications in which the design criterion for every part of a photovoltaic system is the minimum power cost for the complete system. The various parts of a photovoltaic system are grouped so that all costs fall into four classes: fabrication steps of the active solar cells, steps associated with the collector array and its complete structure, power-handling elements such as switchgear, storage, etc., and fixed costs that do not vary directly with any of the system parts, such as factory-level overhead. It is assumed that the total collector area is independent of any of the optimization processes. A general equation is found to be capable of optimizing all parts of a system, although the cell and array steps are basically different from the power-handling elements. It is shown that the optimization of any step in the system requires inclusion of the properties of the other parts of the system. S D

A78-52890 Calculations and in situ experimental data on a water pumping system directly connected to an 1/2 Kw photovoltaic converters array. J A Roger, A Perez, D Campana, A Castiel, and C H S Dupuy (Lyon I, Université, Lyons, France). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p 1211-1220 5 refs

A78-52891 Water pumping system using solar power from photovoltaic source. R Prido (Centre National d'Etudes Spatiales, Paris, France). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p 1221-1228

Various configurations of solar pumping systems are studied, including (1) batteryless systems, (2) systems with a sun-tracking solar generator, (3) systems using solar generators with variable characteristics, and (4) systems using electronic impedance matchers. Combinations of these configurations are also studied. Experimental results are presented along with photographs of some of the configurations. B J

A78-52892 Solar-cell power supplies for radio communication and TV broadcasting equipment (Générateurs solaires pour l'alimentation des équipements de radiodiffusion et de télévision). S Polgar (TéléDiffusion de France, Montrouge, Hauts-de-Seine, France). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p 1229-1242. In French

The use of solar arrays to power microwave links and TV translators and receivers in areas remote from electric utilities is considered. Installations with a peak power of 30 W for supplying TV sets in Africa are described, and specifications for the technical checkout of these installations are discussed. Consideration is also given to rapid calculation methods for sizing such installations, the computer analysis of solar cell characteristics, and the prospects for the increased use of solar arrays for powering TV systems. B J

A78-52893 dc motor characteristics from solar cell supply. J Appelbaum and J Bany (Tel Aviv University, Tel Aviv, Israel). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p 1243-1252

Theoretical and experimental results are presented on the performance of three types of solar cell powered dc motors: separate-excitation, series, and shunt. The torque-current and torque-speed characteristics are plotted as a function of irradiation levels. The motor starts at some irradiation level which is determined by the mechanical load, and the speed varies with load characteristics and irradiation. B J

A78-52894 The effect of temperature within the encapsulation on charging current of solar silicon electric generator. D G S Chuah, S K Tan, C K Koh, R Ratnalingam, C Singh, and M J Basha b Adlan (University of Sciences, Penang, Federation of Malaysia). In Photovoltaic Solar Energy Conference, Luxembourg, September 27-30, 1977, Proceedings. Dordrecht, D Reidel Publishing Co., 1978, p 1253-1260

The response of a 7.2 watt silicon solar electric generator to local atmospheric condition with respect to the cell temperature showed that the charging current deteriorated as the cell temperature approached the maximum operating temperature. A control experiment of two similar units of arrays of silicon solar cells, in which one unit was cooled and the other was not cooled, indicated that the charging current for cells without cooling was less than that for cells which were cooled. (Author)

A78-52895 Reliability simulation of a large solar battery. A Bogomolny, I Gertsbakh, and M Slonim (Negev, University, Beersheba, Israel). In Photovoltaic Solar Energy Conference,

Bhavaraju (Public Service Electric and Gas Co., Newark, N.J.) (*Institute of Electrical and Electronics Engineers, Winter Meeting, New York, N.Y., Jan 29-Feb 3, 1978*) *IEEE Transactions on Power Apparatus and Systems*, vol PAS-97, Sept-Oct 1978, p 1805-1813

This paper evaluates the long range economic benefits of first generation and advanced fuel cells in the future generation capacity plans of a representative electric utility system. The economic benefits of fuel cells' unique characteristics are separately quantified and the relationships between market penetration, fuel price, and capital cost are analyzed. Reliability, production cost, and optimum generation mix methods commonly used for generation planning in utilities were used for this study. The results indicate that the first generation fuel cells are attractive for intermediate duty and second generation for both intermediate and base load duty if the projected goals of capital cost and heat rate can be met (Author)

A78-53248 Raw tidal energy absorption capability of a power system. G B Furst and S Sud (Tidal Power Consultants, Ltd., Montreal, Canada) (*Institute of Electrical and Electronics Engineers, Summer Meeting, Mexico City, Mexico, July 17-22, 1977*) *IEEE Transactions on Power Apparatus and Systems*, vol PAS-97, Sept-Oct 1978, p 1910-1915, Discussion, p 1916, 1917 5 refs

This paper presents a new and efficient semiprobabilistic method developed during the Bay of Fundy studies, to determine the raw tidal energy absorption capability of a power system. This method uses the annual load and tidal duration shapes, but does not require the hourly simulation of system load and tidal generation. The power system constraints on raw tidal energy absorption and the concept of 'must-run' generation together with the modification of the annual load duration curve are also discussed (Author)

A78-53326 Solid state chemistry of energy conversion and storage, *Proceedings of the Symposium, New York, N.Y., April 5-8, 1976*. Symposium sponsored by the American Chemical Society. Edited by J B Goodenough (Oxford University, Oxford, England) and M S Whittingham (Exxon Research and Engineering Co., Linden, N.J.) Washington, D.C., American Chemical Society (Advances in Chemistry Series, No 163), 1977 380 p \$38 50

Hydrogen as an energy carrier is considered along with the catalytic synthesis of hydrocarbons from carbon monoxide and hydrogen, the photoelectrochemical production of hydrogen, the conversion of visible light to electrical energy, solar energy conversion through photosynthesis, photovoltaic solar cells, the recrystallization of semiconducting polycrystalline ribbons using the Peltier effect, wavelength-selective surfaces, thermodynamic studies of some electrode materials, and new solid electrolytes. Attention is given to the sodium-sulfur battery, the chemistry of hot corrosion, non-stoichiometry and disorder in fluorite-related materials for energy conversion, properties relating to the application of solid metal hydrides in solar heating and cooling, the storage of hydrogen isotopes in intermetallic compounds, chemical conversion using sheet-silicate intercalates, and material problems with respect to high temperature electrolysis/fuel cells G R

A78-53327 Hydrogen as an energy carrier - A European perspective of the problem. P Hagenmuller (Bordeaux I, Université, Talence, Gironde, France) In *Solid state chemistry of energy conversion and storage, Proceedings of the Symposium, New York, N.Y., April 5-8, 1976* Washington, D.C., American Chemical Society, 1977, p 1-14 13 refs

The production of low-cost hydrogen may be useful both as energy storage method for nuclear electric-power plants and as feedstock for the chemical energy. In the medium-to-long term, two methods of producing hydrogen more efficiently from nuclear power can be envisioned. These methods are based on electrolysis at medium or high temperature and the thermal decomposition of water with the aid of thermochemical cycles. Both methods use water as raw material. Methods for increasing the efficiency of water

electrolysis are considered along with suitable cycles for the decomposition of water by means of a thermochemical approach. Attention is given to the transport of hydrogen in pipes, the storage of hydrogen in underground cavities, hydrogen storage in the form of hydrides, and safety problems G R

A78-53328 Catalytic synthesis of hydrocarbons from carbon monoxide and hydrogen. M A Vannice (Exxon Research and Engineering Corporate Research Laboratories, Linden, N.J.) In *Solid state chemistry of energy conversion and storage, Proceedings of the Symposium, New York, N.Y., April 5-8, 1976* Washington, D.C., American Chemical Society, 1977, p 15-32 25 refs

Knowledge of the catalytic behavior of the Group VIII metals is an important step toward the achievement of the goal of controlling product selectivity in CO-H₂ reactions. A short review of existing synthesis processes provides a description of the state of the art in CO-H₂ catalysis. Recent research using well-characterized, supported metal catalysts is presented, and the significance of the results is discussed. Attention is given to complicating reactions in CO hydrogenation, the uniqueness of ruthenium with respect to the production of high molecular weight paraffinic waxes, supported metal catalysts, the methanation kinetics over alumina-supported metals, and metal crystallite size effects and metal support interactions G R

A78-53329 Photoelectrochemical production of hydrogen. J O Bockris and K Uosaki (South Australia, Flinders University, Bedford Park, Australia) In *Solid state chemistry of energy conversion and storage, Proceedings of the Symposium, New York, N.Y., April 5-8, 1976* Washington, D.C., American Chemical Society, 1977, p 33-70 91 refs

An efficient process for the photoelectrochemical production of hydrogen would contribute significantly to the solution of the problems of future energy requirements. Gerischer has pointed out that in principle all p- and n type semiconductors can be used for a photocell electrode when a suitable reversible redox system is found which induces the formation of a depletion of a space charge layer. The theory of hydrogen production in a photoelectrochemical cell is considered along with the photochemical reaction on a TiO₂ single crystal, the photoelectrochemical reactions on metal titanates, and the prevention of anodic dissolution of a photon absorber by TiO₂ coatings G R

A78-53330 * Conversion of visible light to electrical energy - Stable cadmium selenide photoelectrodes in aqueous electrolytes. M S Wrighton, A B Ellis, and S W Kaiser (MIT, Cambridge, Mass.) In *Solid state chemistry of energy conversion and storage, Proceedings of the Symposium, New York, N.Y., April 5-8, 1976* Washington, D.C., American Chemical Society, 1977, p 71-92 65 refs NASA-supported research

Stabilization of n-type CdSe to photoanodic dissolution is reported. The stabilization is accomplished by the competitive oxidation of S(-) or S(n)(-) at the CdSe photoanode in an electrochemical cell. Such stabilized cells are shown to sustain the conversion of low energy (not less than 1.7 eV) visible light to electricity with good efficiency and no deterioration of the CdSe photoelectrode or of the electrolyte. The electrolyte undergoes no net chemical change because the oxidation occurring at the photoelectrode is reversed at the cathode. Conversion of monochromatic light at 633 nm to electricity is shown to be up to approximately 9% efficient with output potentials of approximately 0.4 V. Conversion of solar energy to electricity is estimated to be approximately 2% efficient (Author)

A78-53331 Solar energy conversion through photo-synthesis. R K. Clayton (Cornell University, Ithaca, N.Y.) In *Solid state chemistry of energy conversion and storage, Proceedings of the Symposium, New York, N.Y., April 5-8, 1976* Washington, D.C., American Chemical Society, 1977, p 93-108 36 refs

Energy sources of possible quantitative significance which are directly or indirectly of contemporary solar origin are considered, taking into account wind-powered electric generators, ocean thermal gradients, direct solar heating, variations of agriculture, photo-synthetic hydrogen production, and photoelectric devices. The most practical schemes for capturing solar energy appear at this time to be directly heating and harnessing the wind. Silicon photovoltaic cells could contend with these if a means were discovered for reducing their cost sharply. The conversion of organic waste, plants, and algae into fuel has immediate practicality, but on a limited scale relative to the total needs. In comparison with these approaches, the schemes for using photosynthetic tissues in special ways seem highly visionary. However, it is recommended to press forward on all fronts until one or more working systems are established and proven. G. R.

A78-53332 Photovoltaic solar cells. S. Wagner (Bell Telephone Laboratories, Inc., Holmdel, N.J.) In *Solid state chemistry of energy conversion and storage*; Proceedings of the Symposium, New York, N.Y., April 5-8, 1976. Washington, D.C., American Chemical Society, 1977, p. 109-133. 63 refs.

Attention is given to the properties of semiconductor cells which make them suitable for photovoltaic cells, the operation of diodes as solar cells, the photovoltage, the optimum band gap, the direct and indirect band gap, the photocurrent, heterodiodes and Schottky barrier diodes, and approaches for reducing the cost of solar cells. While much progress has been made in analyzing and improving the performance of solar cells, it is not yet possible to predict materials and processes for inexpensive converters. The present situation calls for an increase in the number of available options and for the development of new production techniques, both with a substantial input from chemists. G. R.

A78-53333 Recrystallization of semiconducting polycrystalline ribbons using the Peltier effect. S. Vojdani and R. Hashemian (Arya Mehr University of Technology, Teheran, Iran). In *Solid state chemistry of energy conversion and storage*; Proceedings of the Symposium, New York, N.Y., April 5-8, 1976. Washington, D.C., American Chemical Society, 1977, p. 134-148. 9 refs.

A new approach to zone refining thin semiconductor ribbons or films necessary for the production of low-cost solar cells is investigated using the Peltier effect. The results indicate that under certain conditions the Peltier current tends to stabilize the freezing interface allowing an increase in the grain size of a thin film. (Author)

A78-53334 Wavelength-selective surfaces. J. C. C. Fan (MIT, Lexington, Mass.) In *Solid state chemistry of energy conversion and storage*; Proceedings of the Symposium, New York, N.Y., April 5-8, 1976. Washington, D.C., American Chemical Society, 1977, p. 149-164. 10 refs. USAF-sponsored research.

Wavelength-selective surfaces have important applications in solar-energy collection and energy conservation. Both transparent heat mirrors and selective-black absorbers present challenging material requirements. Although several wavelength-selective films have been developed, materials research in this area continues to be of interest. Attention is given to the mechanisms of heat loss in a flat-plate collector, transparent heat mirrors, an estimate of savings with heat mirrors on domestic windows, and selective-black absorbers. It has been found that MgO/Au cermet films deposited by rf sputtering on metallic substrates are excellent selective-black absorbers. G. R.

A78-53335 Thermodynamic studies of some electrode materials. P. G. Dickens (Oxford University, Oxford, England). In *Solid state chemistry of energy conversion and storage*; Proceedings of the Symposium, New York, N.Y., April 5-8, 1976. Washington, D.C., American Chemical Society, 1977, p. 165-178. 19 refs.

The thermochemistry of a class of ternary oxide phases, the 'oxide bronzes,' $A(x)MO(n)$ is investigated. In this formulation

$MO(n)$ is the highest oxide of a transition metal $M = W, Mo, \text{ or } V$, A is some other electropositive inclusion element such as $Na, K, \text{ or } H$, and x is a variable in the range from 0 to 1. The materials chosen for study are chemically inert towards nonoxidizing acid media and are good electronic conductors, some have previously been examined as potential fuel cell electrodes. Enthalpies of formation of a range of tungsten, molybdenum, and vanadium oxide bronzes are determined. The thermodynamic stability of these materials towards oxidation and disproportionation is examined, and their electrochemical characteristics are discussed. (Author)

A78-53336 New solid electrolytes. H. Y.-P. Hong (MIT, Lexington, Mass.) In *Solid state chemistry of energy conversion and storage*; Proceedings of the Symposium, New York, N.Y., April 5-8, 1976. Washington, D.C., American Chemical Society, 1977, p. 179-194. 13 refs. DARPA-NSF-sponsored research.

Solid electrolytes for fast alkali-ion transport are under investigation for possible use in high-specific-energy secondary batteries, electrolytic cells for extracting metals from molten salts, and thermoelectric generation. A summary is presented of the results of studies which have led to the synthesis of a number of new alkali-ion solid electrolytes. One of these materials is comparable in $Na(+)$ -ion conductivity at 300°C to beta-double-prime alumina, which is presently the leading candidate for use in Na-S high-specific-energy batteries, and another has the highest $K(+)$ ion conductivity so far reported. A description is provided of the crystallographic principles relating to alkali-ion transport that have evolved during the studies. The new materials developed are discussed individually. G. R.

A78-53337 Polarizability enhancement of ionic conductivity for $A(+)$ in $A(+)/M2X6$ series. A. W. Sleight, J. E. Guiley, and T. Berzins (Du Pont de Nemours and Co., Inc., Wilmington, Del.) In *Solid state chemistry of energy conversion and storage*; Proceedings of the Symposium, New York, N.Y., April 5-8, 1976. Washington, D.C., American Chemical Society, 1977, p. 195-204. 43 refs.

The ionic conductivity of $A(+)$ is studied in the isostructural series of the general formula $A(+)/M2X6$ where $A(+)$ is $Rb, Cs, \text{ or } Tl$, M is $Ta, Nb, \text{ or } W$, and X is $O \text{ or } F$. High polarizability of either $A(+)$ or the $(M2X6)(-)$ framework enhances the ionic mobility of $A(+)$. Thus although $Tl(+)$ is essentially the same size as $Rb(+)$, the mobility of $Tl(+)$ is much higher in a given $(M2X6)(-)$ framework. This is attributed to the higher polarizability of $Tl(+)$. The polarizability of the $(M2X6)(-)$ framework is related to the polarizability of $M-X$ bonds. The influence of polarizability in beta-alumina and anion conductors is also discussed. (Author)

A78-53338 The sodium-sulfur battery - Problems and promises. S. A. Weiner (Ford Motor Co., Dearborn, Mich.) In *Solid state chemistry of energy conversion and storage*; Proceedings of the Symposium, New York, N.Y., April 5-8, 1976. Washington, D.C., American Chemical Society, 1977, p. 205-224. NSF Grant No. C-805.

The sodium-sulfur battery consists of two liquid electrodes, sodium and sulfur, and a ceramic electrolyte membrane allowing the transport of sodium ions. The sodium electrode does not present material problems. The operation of the sulfur electrode, however, is quite complex. Because elemental sulfur is an electronic insulator, graphite felt is added to provide a large area electrode. The two major applications currently envisioned for the sodium-sulfur battery are electric utility load leveling and automotive propulsion. The reported program has two goals, including the development of an efficient high energy battery and the development of a low weight, high power battery. Attention is given to the results of cell testing, sodium-sodium cells, sodium-sulfur cells, an examination of sodium-sulfur cells after testing, and a materials costs estimate for a sodium sulfur cell. G. R.

A78-53339 Chemistry of hot corrosion. J. F. Elliott (MIT, Cambridge, Mass.) In *Solid state chemistry of energy conversion and storage*; Proceedings of the Symposium, New York, N.Y., April

5-8, 1976 Washington, D C , American Chemical Society, 1977, p 225-239 34 refs ERDA-supported research

The current view of the chemical aspects of the hot corrosion of ceramic and superalloy materials is discussed The theory based on the acid/base concept is considered by many in the field to account for the corrosion effects that have been observed It is proposed, however, that there may be other phenomena related to physical imperfections and defects in the protective oxide layer on a ceramic or metal part that may be important Surface and electrochemical effects must be considered also in the development of a comprehensive treatment of hot corrosion (Author)

A78-53340 Nonstoichiometry, order, and disorder in fluorite-related materials for energy conversion L Eyring (Arizona State University, Tempe, Ariz) In Solid state chemistry of energy conversion and storage, Proceedings of the Symposium, New York, N Y , April 5-8, 1976 Washington, D C , American Chemical Society, 1977, p 240-270 35 refs ERDA-supported research

Fluorite-related materials in energy-winning roles are considered, taking into account the use of zirconia- and hafnia-based materials and the employment of thorium-rare earth oxide systems as solid electrolytes, fluorite-related oxides for the nuclear industry, fluorite-related ordered phases in the $M_2O_3WO_3$ system, structural characteristics of the $CeO(x)$ system, and the structure and texture in the binary rare earth oxides Structural data on intermediate rare earth oxide phases are presented in a table Attention is also given to calculated images of the ι phase, observed images of the ι phase, the images of phase transformations and intergrowth in fluorite-related binary oxide systems, and the images of beta, epsilon, and zeta phases G R

A78-53341 Solid metal hydrides - Properties relating to their application in solar heating and cooling G G Libowitz and Z Blank (Allied Chemical Corp , Morristown, N J) In Solid state chemistry of energy conversion and storage, Proceedings of the Symposium, New York, N Y , April 5-8, 1976 Washington, D C , American Chemical Society, 1977, p. 271-283 24 refs

Concepts for using solid metal hydrides for solar heating and cooling are described In solar heating the enthalpy of formation of the metal hydride provides a means of storing solar thermal energy, while in cooling the endothermic dissociation of the hydride is used The properties of metal hydrides required for these applications are reviewed, the most important properties being large enthalpies of formation (but relatively low thermal stabilities) and high hydrogen-to-metal ratios. There are two approaches to developing new hydrides to meet these requirements (1) modifying the properties of known hydrides - examples based on the thermodynamics of solids are discussed in some detail, and (2) synthesizing new intermetallic-compound hydrides. (Author)

A78-53342 Storage of hydrogen isotopes in intermetallic compounds S A Steward, J F Lakner, and F Uribe (California, University, Livermore, Calif) In Solid state chemistry of energy conversion and storage, Proceedings of the Symposium, New York, N Y , April 5-8, 1976 Washington, D C , American Chemical Society, 1977, p 284-297 29 refs Contract No W-7405-eng-48

Reaction of $LaCo_5$ under high pressure has produced a hydride with the $LaCo_5H_9$ composition, which is the expected maximum stoichiometry A comparison of hydrogen solubility in $ErCo_5$ with solubilities of previous studies in $PrCo_5$, $PrCo_3$, and $ErCo_3$ show that hydride stability decreases with lanthanide atomic number and with increasing atom ratio of transition metal to lanthanide metal Empirical methods for estimating ternary hydride enthalpies and free energies are evaluated and are found inadequate for calculating approximate hydrogen plateau pressures (Author)

A78-53343 Chemical conversion using sheet-silicate intercalates. J M Thomas, J M Adams, S H Graham, and D T B Tennakoon (University College of Wales, Aberystwyth, Wales) In Solid state chemistry of energy conversion and storage, Proceedings of the Symposium, New York, N Y , April 5-8, 1976

Washington, D C , American Chemical Society, 1977, p 298-315 36 refs

A description is presented of investigations regarding the synthesis of molecular catalysts by means of a utilization of certain sheet silicate structures within which ion-exchange may first be performed Structural studies of the parent silicates and their deliberately modified derivatives were conducted It is pointed out that a wide variation is possible in regard to the nature of the particular cations that can be inserted between the infinite, two-dimensional anions The interlayer spacing, which obviously governs the ease of diffusion of intercalated reactants and products, is, to a degree, adjustable depending, inter alia, upon factors such as the humidity and the nature of the organic molecules present in the system A resume of structural characteristics of sheet silicates is provided and the formation and structural aspects of sheet silicate intercalates are discussed G R

A78-53344 High-temperature electrolysis/fuel cells - Materials problems. H Obayashi and T Kudo (Hitachi, Ltd , Central Research Laboratory, Kokubunji, Tokyo, Japan). In Solid state chemistry of energy conversion and storage, Proceedings of the Symposium, New York, N Y , April 5-8, 1976

Washington, D C , American Chemical Society, 1977, p 316-363. 152 refs.

The motivation for electrolysis/fuel cell technology is summarized, and problems regarding the development of high-temperature electrolysis cells and medium-temperature fuel cells are discussed (1) a suitable solid electrolyte, (2) a cathode for operating in a highly oxidizing atmosphere mechanically compatible with the electrolyte, (3) a cell design that minimizes material and heat transfer problems, and (4) an electronic conductor stable in a wide range of oxygen partial pressures (1-10 to the minus 20th power atm PO_2) for series connection Materials research addressed to solving these problems is reviewed (Author)

A78-53376 Remote-sensing applications for mineral exploration Edited by W L Smith (Michigan, Environmental Research Institute, Arlington, Va) Stroudsburg, Pa , Dowden, Hutchinson and Ross, Inc, 1977 404 p \$50

Consideration is given to mineral exploration on the basis of remotely sensed data Landsat applications are reviewed and the exploration for fossil and nuclear fuels from orbital altitudes is explored Remote sensing projects for energy development are outlined along with geochemical mapping by spectral ratioing methods Remote sensing projects in Brazil and India are noted

S C S

A78-53377 Foreseeable energy and mineral resource problems W L Smith (Michigan, Environmental Research Institute, Arlington, Va) In Remote-sensing applications for mineral exploration Stroudsburg, Pa , Dowden, Hutchinson and Ross, Inc , 1977, p 9-27 27 refs

The paper surveys present and anticipated mineral resource requirements noting the US dependence on foreign sources Projected energy resources are discussed with reference to oil and gas liquids, coal, natural gas, nuclear energy, and geothermal power Landsat projects in monitoring surface water, soil moisture, snow-pack, and for resource mapping are discussed Remote sensing for nonfuel minerals such as beryllium, cobalt, molybdenum, tungsten, and zinc is considered S C S

A78-53382 * Exploration for fossil and nuclear fuels from orbital altitudes. N. M. Short (NASA, Goddard Space Flight Center, Earth Resources Branch, Greenbelt, Md.) In Remote-sensing applications for mineral exploration. Stroudsburg, Pa., Dowden, Hutchinson and Ross, Inc., 1977, p. 157-198.

The paper discusses the application of remotely sensed data from orbital satellites to the exploration for fossil and nuclear fuels. Geological applications of Landsat data are described including map editing, lithologic identification, structural geology, and mineral exploration. Specific results in fuel exploration are reviewed and a series of related Landsat images is included. SCS

A78-53383 The role of remote sensing for energy development. J. E. Johnston (U.S. Geological Survey, Office of Energy, Reston, Va.) and F. J. Janza (California State University, Sacramento, Calif.) In Remote-sensing applications for mineral exploration. Stroudsburg, Pa., Dowden, Hutchinson and Ross, Inc., 1977, p. 199-234. 20 refs.

The application of remote sensing techniques to energy development projects is considered noting the nature of the data collected and the various types of remote sensors available, such as photography devices, infrared scanners, radiometers, and radar systems. Processes for converting sensor data into the necessary form are described including magnification, restoration, image transfer, enhancement, and image coding. Several types of static hardware and image data processors are listed. SCS

A78-53420 Prospects for the use of amorphous semiconductors in solar energy conversion. J. I. B. Wilson and D. Wearie (Heriot-Watt University, Edinburgh, Scotland). *Nature*, vol. 275, Sept. 14, 1978, p. 93-96. 18 refs. Research supported by the Science Research Council.

Potential applications of amorphous Si in the field of solar energy conversion are reviewed. Research has been stimulated by the comparatively low cost anticipated for the industrial production of amorphous Si, and applications such as photovoltaic conversion of solar energy and photothermal conversion are discussed. Amorphous and crystalline Si are compared for use in several specific contexts. The basic principles and parameters for the operation of solar energy devices are indicated, and some data on the performance of amorphous silicon solar cells are presented. M.L.

A78-53424 Photoelectrochemical reduction of aqueous carbon dioxide on p-type gallium phosphide in liquid junction solar cells. M. Halmann (Weizmann Institute of Science, Rehovot, Israel). *Nature*, vol. 275, Sept. 14, 1978, p. 115, 116. 16 refs.

A78-53425 * Variable-temperature cryogenic trap for the separation of gas mixtures. D. J. Des Marais (NASA, Ames Research Center, Extraterrestrial Biology Div., Moffett Field, Calif.). *Analytical Chemistry*, vol. 50, no. 9, Aug. 1978, p. 1405, 1406. Grant No. NGR-05-007-221.

The paper describes a continuous variable-temperature U-shaped cold trap which can both purify vacuum-line combustion products for subsequent stable isotopic analysis and isolate the methane and ethane constituents of natural gases. The canister containing the trap is submerged in liquid nitrogen, and, as the gas cools, the gas mixture components condense sequentially according to their relative vapor pressures. After the about 12 min required for the bottom of the trap to reach the liquid-nitrogen temperature, passage of electric current through the resistance wire wrapped around the tubing covering the U-trap permits distillation of successive gas components at optimal temperatures. Data on the separation achieved for two mixtures, the first being typical vacuum-line combustion products of geochemical samples such as rocks and the second being natural gas, are presented, and the thermal behavior and power consumption are reported. M.L.

A78-53437 Fuel cells for public utility and industrial power. Edited by R. Noyes. Park Ridge, N.J., Noyes Data Corp. (Energy Technology Review, No. 10), 1977. 331 p. \$42.

The various types of fuel cells, their operation, and use are considered along with an assessment of fuels for power generation by electric utility fuel cells, aspects of fuel cell power plant evaluation, and marketing considerations. A description is presented of fuel cells for public utility applications, taking into account aqueous acid fuel cells, alkaline fuel cells, molten carbonate fuel cells, stabilized zirconia fuel cells, the phosphoric acid fuel cell power system, the alkaline fuel cell power system, the molten carbonate fuel cell power system, the solid electrolyte fuel cell power system, approaches to efficiency calculations, the results of parametric assessment, and capital, site-labor, and operation and maintenance costs. Attention is given to an employment of low-temperature and high-temperature fuel cells. G.R.

A78-53438 World energy resources 1985-2020. World energy demand. I. J. Bloodworth, E. Bossanyi, D. S. Bowers, E. A. C. Crouch, R. J. Eden, C. W. Hope, W. S. Humphrey, J. V. Mitchell, D. J. Pullin, and J. A. Stanislaw (Cambridge University, Cambridge, England). Guildford, Surrey, England, IPC Science and Technology Press, 1978. 115 p. \$31.20.

It is concluded that world energy demand in the year 2020 will be between three and four times present consumption if average economic growth is between 3.0 and 4.1 percent per year and if the efficiency of energy use is improved. Various scenarios of world energy demand are examined with reference to regional energy balances. The future roles of several energy sources such as oil and nuclear energy are considered, and assumptions, methodology, and uncertainties are discussed. M.L.

A78-53439 Unconventional energy resources. P. L. Auer (Cornell University, Ithaca, N.Y.), P. B. Bos, V. W. Roberts, and W. C. Gough (Electric Power Research Institute, Palo Alto, Calif.). In World energy resources 1985-2020. Renewable energy resources. Guildford, Surrey, England, IPC Science and Technology Press, 1978, p. 1-7, 9, 11-63 (61 ff.).

Solar energy, geothermal energy, and fusion power are discussed. Solar sources considered include energy derived directly from sunlight and indirectly in the form of wind, waves, tides, ocean thermal gradients, and fuel (from biomass and other photochemical reactions). Hydrogen production, market penetration of solar energy systems, and solar energy in developing nations are examined. Topics related to geothermal energy include resource types, distribution, electric energy conversion, and economics. Subjects related to fusion power include fusion fuel cycles, progress toward scientific feasibility, and safety and environmental aspects. M.L.

A78-53440 Hydraulic resources. E. L. Armstrong (Utah, University, Salt Lake City, Utah). In World energy resources 1985-2020. Renewable energy resources. Guildford, Surrey, England, IPC Science and Technology Press, 1978, p. 129, 131-155, 157-180.

The utilization of hydraulic resources is examined. Favorable features of hydraulic energy are surveyed, and factors affecting the development of hydraulic resources in both industrialized and nonindustrialized countries are discussed. It is estimated that the probable hydroelectric production by 2020 will increase about five times to approximately 28 million terrajoules, which is a little over 80% of the total developable hydroelectric resource reported in the 1976 World Energy Conference Survey. M.L.

A78-53453 Hydrogen. Its technology and implications. Volume 1 - Hydrogen production technology. Volume 2 - Transmission and storage. Edited by K. E. Cox (New Mexico, University, Albuquerque, N. Mex.) and K. D. Williamson (California, University, Los Alamos, N. Mex.). Cleveland, Ohio, CRC Press, Inc., 1977. Vol. 1, 203 p.; vol. 2, 153 p. Price of vol. 1, \$49.95; vol. 2, \$41.50.

Questions of hydrogen production technology are examined, taking into account aspects of water electrolysis, thermochemical water decomposition, hydrogen from fossil fuels, hydrogen from nuclear energy, and hydrogen from solar energy. Problems of hydrogen transmission and storage are also investigated, giving

attention to the transmission of gaseous hydrogen, metal hydrides as hydrogen storage media and their applications, questions of liquid hydrogen storage and transmission, and materials for hydrogen service G R

A78-53454 Water electrolysis. A P Fickett and F R Kalhammer (Electric Power Research Institute, Palo Alto, Calif.) In Hydrogen Its technology and implications. Volume 1.

Cleveland, Ohio, CRC Press, Inc., 1977, p 3-41 37 refs

The fundamentals of water electrolysis are examined, taking into account cell reactions and functional components, cell voltage, cell current density, polarization curves, the effects of temperature on water electrolysis, the effects of pressure on water electrolysis, and the electrolysis module or stack. The generic types of water electrolysis systems are discussed along with electrolysis system requirements, water electrolysis technologies, and the economics of water electrolysis. Attention is given to the unipolar electrolyzer, the bipolar electrolyzer, aspects of power conditioning and control, cooling fluid circulation and control, product gas-water removal, electrolyte monitoring and control, instrumentation and controls, capital costs, operating costs, and the relationship of hydrogen cost to capital and operating costs G R

A78-53455 * Thermochemical water decomposition. J E Funk (Kentucky, University, Lexington, Ky.) In Hydrogen Its technology and implications. Volume 1. Cleveland, Ohio, CRC Press, Inc., 1977, p. 45-57 36 refs NASA-supported research

At present, nearly all of the hydrogen consumed in the world is produced by reacting hydrocarbons with water. As the supply of hydrocarbons diminishes, the problem of producing hydrogen from water alone will become increasingly important. Furthermore, producing hydrogen from water is a means of energy conversion by which thermal energy from a primary source, such as solar or nuclear fusion or fission, can be changed into an easily transportable and ecologically acceptable fuel. The attraction of thermochemical processes is that they offer the potential for converting thermal energy to hydrogen more efficiently than by water electrolysis. A thermochemical hydrogen-production process is one which requires only water as material input and mainly thermal energy, or heat, as an energy input. Attention is given to a definition of process thermal efficiency, the thermodynamics of the overall process, the single-stage process, the two-stage process, multistage processes, the work of separation and a process evaluation G R

A78-53456 Hydrogen from fossil fuels. R I Kermode (Kentucky, University, Lexington, Ky.) In Hydrogen Its technology and implications. Volume 1. Cleveland, Ohio, CRC Press, Inc., 1977, p 61-115 90 refs

Questions concerning the present and historical industrial use of hydrogen are examined. Ammonia and methanol account for almost 50% of the total US consumption of hydrogen. General process considerations with respect to the water-gas shift reaction and acid-gas removal are discussed, taking into account equilibrium conditions, the process flowsheet, high-temperature low-temperature shift-conversion catalysts, aspects of reactor design, ammonia solution absorption, ethanolamine absorbent systems, alkaline salt processes, the hot carbonate process, and absorption in cold methanol. The different commercial processes are considered, giving attention to process economics, the catalytic decomposition of methane, catalytic steam reforming of hydrocarbons, the catalytic partial oxidation of hydrocarbons, noncatalytic partial oxidation, the steam-iron process, and hydrogen from coal G R

A78-53457 Hydrogen from nuclear energy. R J Jaconetti (California, University, Los Alamos, N. Mex.) In Hydrogen Its technology and implications. Volume 1. Cleveland, Ohio, CRC Press, Inc., 1977, p. 119-141 34 refs

The predicted domestic energy supply and demand deficit could be met by expanded utilization of the large domestic reserve of coal and uranium as fuels and for the production of synthetic liquid and

gaseous fuels. The graphite moderated gas-cooled reactors presently under development are potentially capable of producing the highest process temperatures (about 1800 F) that could be required for larger high-temperature process applications. The development requirements for the realization of a nuclear heat source in high-temperature industrial processes are discussed, taking into account reactor and fuels, materials, and heat-exchange and process systems. Details of hydrogen production with nuclear process heat are considered, giving attention to steam reforming, hydrogen from coal with nuclear process heat, hydrogen from water by thermochemical decomposition with nuclear process heat, and nuclear process heat and the energy future. G R

A78-53458 Hydrogen from solar energy. K E Cox (New Mexico, University, Albuquerque, N. Mex.) In Hydrogen Its technology and implications. Volume 1. Cleveland, Ohio, CRC Press, Inc., 1977, p 145-175 44 refs

Both coal and nuclear energy are considered the primary energy sources from which hydrogen will be produced in the near term. However, alternate energy sources must be sought and developed for the long term. The most obvious energy source possessing the required attributes is solar energy. Use of solar energy has not become widespread largely due to the costs of its collection, conversion, and storage. To use solar energy as a major source of energy, it is highly desirable to be able to store it in a concentrated form that can be easily transported. A candidate system that appears to offer high potential for solar energy conversion and storage is that of the decomposition of water into hydrogen and oxygen. Attention is given to the solar resource, proposed methods of solar energy conversion, ocean thermal energy conversion, power from wind, biomass, artificial solar collection schemes, methods of solar energy conversion to hydrogen, photosynthetic methods, and the economics of hydrogen production from solar energy G R

A78-53459 Transmission of gaseous hydrogen. G G Leeth (General Electric Tempo, Santa Barbara, Calif.) In Hydrogen Its technology and implications. Volume 2. Cleveland, Ohio, CRC Press, Inc., 1977, p 3-10 13 refs

For any hydrogen energy system, pipeline transport of gaseous hydrogen is clearly a major element. A summary is provided of the present status of hydrogen pipeline knowledge. Gas pipelines are considered along with aspects of gas pipeline dynamics, gas pipeline costs, hydrogen pipeline analyses, hydrogen pipeline safety, and hydrogen pipeline operating experience. It is found that the transmission of hydrogen gas in a large pipeline network is technically and economically feasible. For large energy flow rates, the transmission cost would be approximately 50% greater per energy unit than for natural gas. Sufficient experience is available to be confident that hydrogen pipelines can be designed, built, and safely operated on a commercially profitable basis. Modification of existing natural gas pipelines to transport hydrogen is probably feasible G R

A78-53460 Metal hydrides as hydrogen storage media and their applications. J J Reilly (Brookhaven National Laboratory, Upton, N.Y.) In Hydrogen Its technology and implications. Volume 2. Cleveland, Ohio, CRC Press, Inc., 1977, p 13-48 62 refs ERDA-sponsored research

Perhaps the most important factor which limits the use of hydrogen at the present time is the difficulty involved in storing it conveniently and economically. A gaseous storage of hydrogen for use as a common mobile or stationary fuel is not feasible because of the large volume and/or weight of the storage vessels. The storage of hydrogen in the liquid form is expensive and uneconomical in connection with the energy required by the liquefaction process. One potentially attractive alternative to conventional storage methods is storage as a metal hydride. Aspects of metal hydride chemistry are considered along with specific metal-hydrogen systems and their properties. Attention is given to magnesium and magnesium alloys, rare earth alloys, iron-titanium alloys, and vanadium dihydride G R

- A78-53461** Liquid hydrogen storage and transmission F J Edeskuty and K D Williamson, Jr (California, University, Los Alamos, N Mex.) In *Hydrogen Its technology and implications* Volume 2 Cleveland, Ohio, CRC Press, Inc., 1977, p 51 81 46 refs

Liquid hydrogen properties relative to storage and handling are considered along with the current state of the art with respect to storage, transport, and transfer in vacuum jacketed lines Design and operational considerations concerning storage systems and transfer systems are discussed, taking into account sources of heat, insulation systems, structural materials, instrumentation, design and construction, and operations The discussion gives ample evidence of the existence of a well-developed liquid hydrogen technology Because of the care which was taken in the anticipation of problems, it has been possible to produce, transport, store, and use hundreds of millions of gallons of liquid hydrogen while maintaining an admirable safety record

G R

- A78-53462** Materials for hydrogen service A W Thompson (Rockwell International Science Center, Thousand Oaks, Calif.) In *Hydrogen Its technology and implications* Volume 2 Cleveland, Ohio, CRC Press, Inc., 1977, p 85-124 71 refs

Manifestations of hydrogen damage are considered along with materials characteristics for hydrogen service, taking into account tensile tests, delayed failure and fracture mechanics, fracture surface appearance, effects at elevated temperature, composition, microstructure, strength level, weldability, and cost The behavior of alloy systems in hydrogen is examined, giving attention to ferritic and martensitic steels, austenitic stainless steels, age-hardening stainless steels, titanium alloys, nickel alloys, aluminum alloys, and high-temperature materials The structural behavior of engineering systems is discussed and a description is provided of hydrogen energy system applications

G R

- A78-53463** The fate of fossil fuel CO₂ in the oceans Edited by N R Andersen (NSF, Washington, D C) and A Malahoff (NOAA, Rockville, Md.) New York, Plenum Press (Marine Science Volume 6), 1977 760 p \$59 50

Carbon in the atmosphere and in the ocean is considered, taking into account the fossil fuel problem and carbon dioxide, the influence of the southern oscillation on atmospheric carbon dioxide, hydrogen ions and the thermodynamic state of marine systems, seasonal patterns in suspended calcium carbonate concentrations during the dry and wet seasons in the eastern Caribbean, modeling the oceans and ocean sediments and their response to fossil fuel carbon dioxide emissions, and the land's response to more carbon dioxide Aspects of carbonate dissolution are examined, giving attention to the neutralization of fossil fuel carbon dioxide by marine calcium carbonate, the sedimentation and dissolution of pteropods in the ocean, biogenic carbonate particles in the ocean, the carbonate chemistry of North Atlantic ocean deep-sea sediment pore water, and the mechanisms for calcite dissolution on the sea floor Aspects of sediments and sedimentation are also discussed

G R.

- A78-53464** Modeling in the oceans and ocean sediments and their response to fossil fuel carbon dioxide emissions. B Bolin (Stockholm, Universitet Stockholm, Sweden) In *The fate of fossil fuel CO₂ in the oceans* New York, Plenum Press, 1977, p 81 95 22 refs

The continuity equation for the distribution of an arbitrary tracer in a water body is integrated with due regard to the basic characteristics of the ocean circulation to deduce a multiple reservoir model for the carbon cycle Methods for evaluating the flux of carbon between the reservoirs are presented in some detail Awaiting results from a series of model computations, some principle characteristics are pointed out, particularly the dependence of the downward flux of carbon into the sea on the sinking of detritus and thus, of the biological production in the surface layers of the ocean The possible role of man's input of phosphorus into coastal waters (and possibly the open sea) is assessed

(Author)

- A78-53465** The land's response to more carbon dioxide. E Lemon (U S Department of Agriculture, Agricultural Research Service, Washington, D C) In *The fate of fossil fuel CO₂ in the oceans* New York, Plenum Press, 1977, p 97-130 37 refs

An investigation is conducted concerning land plant synthesis and carbon accumulation in response to added carbon dioxide in the atmosphere The hierarchy of yield response is considered, taking into account the primary biochemical CO₂ fixation level, the intact mesophyll cell level, the intact leaf level, the daytime net photosynthesis of pure crop stands, and the short-term crop growth rate in pure stands The photosynthesis response to CO₂ is discussed, giving attention to leaf chamber studies, field chamber studies, and the modeling of short-term response Growth cabinet studies are discussed along with the modeling of long-time response, the living forest biomass, and the soil humus pool

G R

- A78-53467** Global carbon dioxide production from fossil fuels and cement, A D 1950-A D 2000 R M Rotty (Institute for Energy Analysis, Oak Ridge, Tenn.) In *The fate of fossil fuel CO₂ in the oceans* New York, Plenum Press, 1977, p 167-181 7 refs

- A78-53468** Neutralization of fossil fuel CO₂ by marine calcium carbonate W S Broecker (Lamont-Doherty Geological Observatory, Palisades, N Y) and T Takahashi (Queens College, Queens, N Y) In *The fate of fossil fuel CO₂ in the oceans* New York, Plenum Press, 1977, p 213-241 15 refs NSF Grant No OCE-72-06419, Contract No E(11-1)-2185

Carbon dioxide generated by the combustion of fossil fuels will ultimately be neutralized through combination with sedimentary calcium carbonate Regardless of whether this dissolution takes place on land or in the sea, the calcium and bicarbonate ions generated will end up as part of the ocean's dissolved salt load Some of the details of this process are considered For the purposes of the discussion, the sediments of the sea are divided into five categories A basis for future dissolution rate estimates is considered along with the time constant for sediment dissolution A model is presented for the dissolution of sediment in the western basin of the Atlantic Ocean

G R.

- A78-53487** Materials and energy, Selected topics. Edited by J H Wernick (Bell Telephone Laboratories, Inc., Murray Hill, N J) Amsterdam, North-Holland Publishing Co (*Journal of Crystal Growth*, vol 39), 1977 217 p \$39 25

Topics relevant to the application of photovoltaic materials, novel electrode materials, and solid electrolytes for use in solar cells are discussed Techniques for reducing the cost of silicon solar cells are examined with attention to improved procedures for crystal growth and solar cell fabrication Information derived from single-crystal studies is reported, and the prospects of using materials other than silicon for solar cells are explored Transition-metal chalcogenides and electrode materials are described

M L.

- A78-53488** The growth of EFG silicon ribbons K V Ravi (Mobil Tyco Solar Energy Corp., Waltham, Mass.) In *Materials and energy, Selected topics* Amsterdam, North-Holland Publishing Co., 1977, p 1-16 33 refs

The technology associated with the Edge-Defined, Film-Fed Growth (EFG) process of producing ribbon-shaped crystals of silicon is discussed Aspects relating to the growth of crystals, equipment and theoretical considerations are presented The crystallographic and electrical characteristics of these crystal are discussed in terms of their impact on the performance characteristics of solar cells Solar cell data are presented demonstrating the capability of these crystals of furnishing cells with conversion efficiencies in excess of 10%

(Author)

- A78-53489 *** Dendritic web silicon for solar cell application. R G Seidensticker (Westinghouse Research Laboratories, Pittsburgh, Pa.) In *Materials and energy, Selected topics*

Amsterdam, North-Holland Publishing Co., 1977, p 17-22 18 refs
USAF-supported research, Contracts No NAS3-18034, No NAS3-19439

The dendritic web process for growing long thin ribbon crystals of silicon and other semiconductors is described. Growth is initiated from a thin wirelike dendrite seed which is brought into contact with the melt surface. Initially, the seed grows laterally to form a button at the melt surface, when the seed is withdrawn, needlelike dendrites propagate from each end of the button into the melt, and the web portion of the crystal is formed by the solidification of the liquid film supported by the button and the bounding dendrites. Apparatus used for dendritic web growth, material characteristics, and the two distinctly different mechanisms involved in the growth of a single crystal are examined. The performance of solar cells fabricated from dendritic web material is indistinguishable from the performance of cells fabricated from Czochralski grown material. M L

A78-53490 Epitaxial silicon solar cells on 'ribbon' substrates. H Kressel, R V D'Aiello, E R Levin, P H Robinson, and S H McFarlane (RCA Laboratories, Princeton, N.J.) In Materials and energy, Selected topics. Amsterdam, North-Holland Publishing Co., 1977, p 23-44 7 refs NSF Grant No AER-74-15532

The paper describes the use of thin (approximately 50-micron) epitaxial layers formed from high-purity dichlorosilane and grown on Si in ribbon form to obtain solar cells. Characteristics of these diodes are reported. The epitaxial silicon solar cells are found to perform better than solar cells prepared by a direct diffusion process. The reasons for the differences in performance are examined with attention to electrical properties, solar cell structures, and the effects of major defects (boundary effects and the effects of large inclusions). M L

A78-53491 Silicon films on foreign substrates for solar cells. T L Chu (Southern Methodist University, Dallas, Tex.) In Materials and energy, Selected topics. Amsterdam, North-Holland Publishing Co., 1977, p 45-60 22 refs Contract No E(04-3)-1285

Silicon films on foreign substrates have been used for various device applications for over fifteen years. The current interest in the photovoltaic conversion of solar energy for terrestrial applications has stimulated investigations on the feasibility of using polycrystalline silicon films on low-cost substrates for solar cell purposes. In this paper, the deposition and properties of silicon films on several low cost substrates, such as steel, aluminum, graphite, and metallurgical silicon, are reviewed. The characteristics of solar cells prepared from these films are discussed. The present results indicate that the deposition of a silicon film containing a p-n junction on a purified recrystallized metallurgical silicon substrate is a promising approach for the fabrication of low-cost solar cells for terrestrial applications. (Author)

A78-53492 Materials aspects of Cu₂S for CdS/Cu₂S solar cells. H C Hadley, Jr and W F Tseng (Delaware University, Newark, Del.) In Materials and energy, Selected topics. Amsterdam, North-Holland Publishing Co., 1977, p 61-72 29 refs NSF Grant No AER-72-03478

Renewed interest in CdS/Cu₂S solar cells has led to significant improvements in conversion efficiency and theoretical understanding. These developments are discussed from the viewpoint of the material properties of the copper sulfide necessary for efficient thin film polycrystalline devices. Both the bulk electronic properties and the structural aspects are shown to play a role in the device operation. A clearer understanding of the role these properties play in device operation may lead to even further improvements in efficiency or to processing compromises for cost reduction. (Author)

A78-53493 II-VI compounds in solar energy conversion. A L Fahrenbruch (Stanford University, Stanford, Calif.) In Materials and energy, Selected topics. Amsterdam, North-Holland Publishing Co., 1977, p 73-91 99 refs

The preparation of thin (2-10 micron) films of II-VI compounds and their application in heterojunction solar cells are discussed. Advantageous features of heterojunction cells are considered, and properties of CdS, CdSe, CdTe, ZnTe, ZnSe, ZnS, ZnCdS, ZnSeS, and CuInSe₂ are reviewed. Simple models are proposed for determining the effects of grain boundaries in thin films and heterojunction lattice mismatch, and the results are considered in the context of required film properties and cell configurations. Experimental results are presented for a number of heterojunctions with particular attention directed to the CdS/CdTe cell. M L

A78-53494 CdS thin films for terrestrial solar cells. L M Fraas (Hughes Research Laboratories, Malibu, Calif.) and Y Ma (Stanford University, Palo Alto, Calif.) In Materials and energy, Selected topics. Amsterdam, North-Holland Publishing Co., 1977, p 92-107 41 refs

Four different polycrystalline thin-film CdS-based solar cells have been reported with conversion efficiencies in excess of 5%. These cells (Cu₂S/CdS, CdTe/CdS, InP/CdS, and CuInSe₂/CdS) are briefly reviewed here. It is noted that present economic projections require the fabrication of terrestrial solar cells with 10% conversion efficiency, a constructed array cost of \$60/sq m, and at volumes of approximately 100 million sq m/yr. The paper describes some of the physical constraints on CdS thin films and the economic constraints on CdS thin film fabrication, imposed, respectively, by the 10% conversion efficiency requirement and the low-cost production scale-up requirement. (Author)

A78-53495 * LPE growth of GaAs-Ga(1-x)Al(x)As solar cells. J M Woodall and H J Hovel (IBM Thomas J Watson Research Center, Yorktown Heights, N.Y.) In Materials and energy, Selected topics. Amsterdam, North-Holland Publishing Co., 1977, p 108-116 11 refs NASA-supported research

The procedures for the liquid phase epitaxial (LPE) growth of high efficiency p-Ga(1-x)Al(x)As, p-GaAs, n-GaAs solar cells have been developed. The methods are based on forming the structure by a one-step process in which the Zn-diffused p-n junction in the n-type GaAs substrate forms in conjunction with the LPE growth of the Zn-doped p-Ga(1-x)Al(x)As layer. For structures with 1-10 micron thick Ga(1-x)Al(x)As layers, an isothermal soak of the GaAs substrate in a saturated Ga-Al-As Zn melt followed by ramp cooling produces good cells. For structures with less than one micron thick Ga(1-x)Al(x)As layers, it is necessary to isothermally soak the GaAs substrate in an undersaturated melt, and ramp cooling is not required. (Author)

A78-53496 Vapor-phase-epitaxial growth of n-AlAs/p-GaAs solar cells. W D Johnston, Jr (Bell Telephone Laboratories, Inc., Holmdel, N.J.) In Materials and energy, Selected topics. Amsterdam, North-Holland Publishing Co., 1977, p 117-127 20 refs

The described procedure for producing high performance heterostructure solar cells involves the chloride-transport vapor-phase growth of n-AlAs on p-GaAs single-crystal substrates in an all-alumina reactor. The same technique and conditions can be applied to grow AlAs layers on polycrystalline films of GaAs on graphite substrates, and it is suggested that this material can be used for less expensive lower-performance cells after some problems relating to compatible contracting technology are resolved. The stability of single-crystal and polycrystal AlAs layers is considered, and the suitability of the vapor-phase growth method for large-scale production is examined. M L

A78-53497 Chemistry and preparation of InP/CdS solar cells. S Wagner, J L Shay, M Bettini (Bell Telephone Laboratories, Inc., Holmdel, N.J.), K J Bachmann, and E Buehler (Bell Telephone Laboratories, Inc., Holmdel and Murray Hill, N.J.) In Materials and energy, Selected topics. Amsterdam, North-Holland Publishing Co., 1977, p 128-136 17 refs

The p-InP/n-CdS heterodiode has reached Air Mass 2 solar conversion efficiencies of 150% in single crystal and 57% in polycrystalline thin film form. After a brief description of the physical principles of this solar cell, an account of its preparation and characterization is given. Key results are included on photocurrent, photovoltage, quantum efficiency, as well as on stability and operation at high temperature (Author)

A78-53498 The current status of the preparation of single crystals, bicrystals, and epitaxial layers of p-InP and of polycrystalline p-InP films for photovoltaic applications. K. J. Bachmann, E. Buehler, F. A. Thiel (Bell Telephone Laboratories, Inc., Murray Hill, N.J.), B. I. Miller, and J. H. McFee (Bell Telephone Laboratories, Inc., Murray Hill and Holmdel, N.J.) In *Materials and energy*, Selected topics. Amsterdam, North-Holland Publishing Co., 1977, p. 137-150. 68 refs

A78-53499 Multicomponent tetrahedral compounds for solar cells. S. Wagner and P. M. Bridenbaugh (Bell Telephone Laboratories, Inc., Holmdel, N.J.) In *Materials and energy*, Selected topics. Amsterdam, North-Holland Publishing Co., 1977, p. 151-159. 72 refs

Preparation and properties are reviewed of solar cells based on multicomponent compounds. Cells made with CuInSe₂, CuInS₂, and CuGaSe₂ are discussed in detail. New results are presented on single-crystal p-CuInS₂/n-CdS and p-Cu₂CdSnS₄/n-CdS heterodiodes (Author)

A78-53500 Ionic and mixed conductors for energy storage and conversion systems. D. H. Whitmore (Northwestern University, Evanston, Ill.) In *Materials and energy*, Selected topics. Amsterdam, North-Holland Publishing Co., 1977, p. 160-179. 122 refs. Contract No. EY-76-S-02-2564

Experimental information is reviewed on the structures and the ionic transport properties of a number of solids which are predominantly ionic conductors possessing unusually mobile selected ionic species. The structural criteria for finding fast ionic diffusivity in such solid phases (fast ion conductors) is discussed and the current status of the theory of optimized ionic conduction in solid electrolyte materials is reviewed. Recent data on selected materials which exhibit tunnel or layer structures, within which significant charge transport occurs due to the motion of both ionic and electronic species (mixed conductors), is also discussed. Emphasis is placed on those mixed conductors which might find application as cathode materials in secondary cells (Author)

A78-53502 Metal chalcogenides as reversible electrodes in nonaqueous lithium batteries. D. W. Murphy and F. A. Trumbore (Bell Telephone Laboratories, Inc., Murray Hill, N.J.) In *Materials and energy*, Selected topics. Amsterdam, North-Holland Publishing Co., 1977, p. 185-199. 46 refs

The paper describes the preparation and properties of the transition metal chalcogenides as reversible cathode materials and explains the materials aspects of lithium batteries involving the di-, tri-, and tetrachalcogenides of niobium and/or titanium. A number of transition metal chalcogenides possessing van der Waals bonded structures undergo topotactic reactions with lithium, and, as this type of reaction is often quite reversible, it provides the basis for a new class of secondary lithium batteries. Structures, electrochemistry, and changes that occur during lithiation are summarized. M. L.

A78-53503 Electrode materials for photoelectrochemical devices. A. J. Nozik (Allied Chemical Materials Research Center, Morristown, N.J.) In *Materials and energy*, Selected topics. Amsterdam, North-Holland Publishing Co., 1977, p. 200-209. 57 refs

The theory and experimental status of energy conversion using photoelectrochemical devices is reviewed. Two classes of devices are considered: photoelectrolysis cells and electrochemical photovoltaic cells. The advantages of these devices, as well as associated unique materials problems, are discussed and compared to all solid-state devices (Author)

A78-53519 # Solar power plant with folding concentrator for carrying out industrial processes in space (Solnechnaia energeticheskaia ustanovka so skladyvayushchimsia kontsentratorom dlia osushchestvleniia tekhnologicheskikh protsessov v kosmicheskom prostranstve). I. N. Frantsevich, V. S. Dverniakov, V. V. Pasichnyi, I. E. Kasich-Pilipenko, A. F. Rozhenko, and D. K. Sattarov (*International Astronautical Federation, International Astronautical Congress, 27th, Anaheim, Calif., Oct. 10-16, 1976*) *Kosmicheskie issledovaniia na Ukraine*, no. 11, 1977, p. 70-74. 7 refs. In Russian

The folding solar power plant is designed according to a Mersenne optical arrangement with Fresnel lens, in which a power fiber optical waveguide is used to transmit the high-density luminous flux. The weight of the paraboloidal concentrator, counterreflector, focusing lens, and all other structural components is 60 kg. The ground version is the Helios 2 installation, on which experimental investigations are being carried out on melting, welding, soldering, and cutting of metals with the aid of concentrated solar energy. The possibilities of the installation for space operation are evaluated on the basis of results obtained so far. P. T. H.

A78-53610 * # Advantages of thin silicon solar cells for use in space. O. S. Denman (Boeing Aerospace Co., Seattle, Wash.). *American Astronautical Society and Deutsche Gesellschaft für Luft- und Raumfahrt, Goddard Memorial Symposium, 16th, Washington, D.C., Mar. 8-10, 1978, AAS Paper 78-024a*. 12 p. 5 refs. Contract No. NAS9-15196

A system definition study on the Solar Power Satellite System showed that a thin, 50 micrometers, silicon solar cell has significant advantages. The advantages include a significantly lower performance degradation in a radiation environment and high power-to-mass ratios. The advantages of such cells for an employment in space is further investigated. Basic questions concerning the operation of solar cells are considered along with aspects of radiation induced performance degradation. The question arose in this connection how thin a silicon solar cell had to be to achieve resistance to radiation degradation and still have good initial performance. It was found that single-crystal silicon solar cells could be as thin as 50 micrometers and still develop high conversion efficiencies. It is concluded that the use of 50 micrometer silicon solar cells in space-based photovoltaic power systems would be advantageous. G. R.

A78-53639 The application of a 2-D convective cloud model to waste heat release from proposed nuclear energy centers. C. E. Hane (Battelle Pacific Northwest Laboratories, Richland, Wash.). *Atmospheric Environment*, vol. 12, no. 9, 1978, p. 1839-1848. 20 refs. Contract No. E(45-1)-1830

A78-53653 The importance of the electron affinity of oxide-semiconductors as used in solar cells. R. Singh and J. Shewchun (McMaster University, Hamilton, Ontario, Canada). *Applied Physics Letters*, vol. 33, Oct. 1, 1978, p. 601-603. 14 refs. Contract No. E(04-3)-1203

Oxide semiconductors (such as In₂O₃ and SnO₂) may be used to form barrier devices on semiconductors with high photovoltaic conversion efficiencies. It is noted that the electron affinity of such semiconductors as found by electrical measurements of oxide-semiconductor/base-semiconductor systems are often incorrect. Thus electron affinity must be determined on the basis of techniques which do not incorporate the electrical parameters of the device. S. C. S.

A78-53654 Vapor-grown InGaP/GaAs solar cells. G. H. Olsen, M. Ettenberg, and R. V. D'Aiello (RCA Laboratories, Princeton, N.J.) *Applied Physics Letters*, vol. 33, Oct. 1, 1978, p. 606-608. 9 refs

The GaCl/AsH₃ hydride technique was used to grow GaAs solar cells with conversion efficiencies to 14% at Am1. The GaAs top surface was passivated by thin InGaP layers and a 70-fold increase in photoluminescence was observed. Open-circuit voltages to 0.96 V and short-circuit current densities to 22 mA/sq cm were reported. Increasing p-layer thickness caused increased open-circuit voltage, fill

factor, and conversion efficiency. Decreasing p-layer thickness caused increased short-circuit current density. SCS

A78-53658 A 15% efficient silicon MIS solar cell. R. B. Godfrey and M. A. Green (New South Wales, University, Kensington, Australia). *Applied Physics Letters*, vol. 33, Oct. 1, 1978, p. 637-639. 11 refs. Research supported by the Australian Research Grants Committee, Electrical and Radio Research Boards of Australia, and Utah Foundation.

Substantial improvements in energy conversion efficiency are reported for silicon MIS solar cells fabricated on both single-crystalline and semicrystalline substrates. Based on active area, AM1 efficiencies of 15.1% and 12.6%, respectively, have been obtained for 3.1-sq-cm cells at 26°C. (Author)

A78-53659 Fabrication and characterization of indium tin oxide (ITO)/polycrystalline silicon solar cells. G. Cheek, N. Inoue, S. Goodnick, A. Genis, C. Wilmsen, and J. B. DuBow (Colorado State University, Fort Collins, Colo.). *Applied Physics Letters*, vol. 33, Oct. 1, 1978, p. 643-645. 17 refs.

Efficient indium tin oxide (ITO)/polycrystalline silicon heterojunction solar cells have been fabricated utilizing neutralized ion-beam sputtering techniques. These cells were fabricated on single-pass float-zone-refined silicon. Conversion efficiencies of 6.25% under AM1 illumination have been observed. Cells were analyzed by I-V characteristics and a scanning laser photoresponse technique. Qualitative minority-carrier lifetime has been mapped using the EBIC mode of a SEM. This has revealed a reduced photoresponse at the grain boundaries independent of grain size, and also at defect clusters within individual grains. Surface blemishes and etch pits are not important in reducing the cell photoresponse. It appears that the low-temperature processing inherent in semiconductor-insulator-semiconductor solar cells is applicable to polycrystalline material. (Author)

A78-53681 Theory of finite-beta-modified drift waves. L. Chen, J. Hsu, P. K. Kaw, and P. H. Rutherford (Princeton University, Princeton, N.J.). *Nuclear Fusion*, vol. 18, Oct. 1978, p. 1371-1378. 8 refs. Contract No. EY-76-C-02-3073.

A theory is presented for radial eigenmode analyses of finite-beta-modified drift waves in a sheared magnetic field. The finite-beta effects are separated from electrostatic effects. On the basis of three spatial scales, a matching procedure is used to find the finite-beta effects. A perturbation analysis is used to include electrostatic effects. The theory is applied to the universal drift mode. An analysis is also made of the corresponding eigenmode structure, noting finite magnetic perturbations. SCS

A78-53682 Plasma energy confinement in conventional mirrors with externally heated electrons. H. L. Berk, D. L. Correll, M. E. Rensink (California, University, Livermore, Calif.), and C. Gormezano (California, University, Livermore, Calif., EURATOM and Commissariat à l'Energie Atomique, Grenoble, France). *Nuclear Fusion*, vol. 18, Oct. 1978, p. 1379-1388. 13 refs. Contract No. W-7405-eng-48.

By means of a 2-D, multi-species, Fokker-Planck code, it is found for conventional mirror reactors that heating of the electrons from an external power source leads to a decrease in Q . Likewise, for mirror plasmas such as 2X11B, electron heating does not improve the total energy confinement because of additional losses associated with quasi-linear stabilization requirements. (Author)

A78-53683 Non-linear saturation of the trapped-ion mode by mode coupling in two dimensions. B. I. Cohen and W. M. Tang (Princeton University, Princeton, N.J.). *Nuclear Fusion*, vol. 18, Oct. 1978, p. 1389-1416. 21 refs. Contracts No. E(11-1) 3073, No. W-7405-eng-48.

Consideration is given to the nonlinear saturation by mode coupling of the dissipative trapped-ion mode, noting both radial and poloidal variations. The derivation of the nonlinear model equation is presented noting the systematic addition of weakly perturbative

kinetic effects to the Kadomtsev-Pogutse fluid equations. Attention is given to the radial instability of one-dimensional equilibria and to two-dimensional equilibria established by three-wave interactions. The case very close to linear marginal stability is examined where a single unstable mode couples with itself via a four-wave interaction. Calculations are presented for the transport of particle flux and the scalings of the transport coefficient. The saturated amplitude with tokamak parameters is reported. SCS

A78-53685 Numerical computation of the density profile produced by 10.6-micron irradiation of an SiO₂ microballoon. M. A. Strosio, D. B. Henderson (California, University, Los Alamos, N. Mex.), and A. G. Petschek. *Nuclear Fusion*, vol. 18, Oct. 1978, p. 1425-1430. 27 refs.

The paper presents a two-dimensional numerical simulation of the time-dependent density profile produced by the irradiation of a 200-micron-diameter SiO₂ microballoon with a two-beam CO₂ laser operating at 0.5 kJ. Each laser beam is assumed to have a Gaussian spot profile containing 80% of the energy in a 180-micron diameter, a temporal profile rising to a peak at 200 ps, and a 250-J energy. The results are considered with reference to (1) absorption measurements which are based on the assumption that scattered light emanates from a point source, (2) the unification of previous calculations, and (3) expanding plasma symmetry. SCS

A78-53686 Feedback stabilization of axisymmetric MHD instabilities in tokamaks. E. Rebhan (Max-Planck-Institut für Plasmaphysik GmbH, Garching, Dusseldorf, Universität, Dusseldorf, West Germany) and A. Salat (Max-Planck-Institut für Plasmaphysik GmbH, Garching, West Germany). *Nuclear Fusion*, vol. 18, Oct. 1978, p. 1431-1444. 35 refs. EURATOM-sponsored research.

A stability principle is derived and applied to simple tokamak configurations in order to study feedback stabilization of unstable, vertically elongated tokamak plasmas. For practical applicability it is assumed that the fast instabilities are slowed down by passive conductors so that only slow motions have to be considered. Numerical results are presented for a surface current model of plasma with one conjugate pair of axisymmetric feedback loops. Stabilization is possible, except in a limited region of loop positions. The optimum loop position in the region with possible stabilization is determined. (Author)

A78-53690 Laser acceleration of reactor-fuel pellets. F. S. Felber (General Atomic Co., San Diego, Calif.). *Nuclear Fusion*, vol. 18, Oct. 1978, p. 1469-1471. 15 refs. Research supported by the Electric Power Research Institute.

A method for fuelling a fusion power reactor by the injection of pellets accelerated by laser-produced ablation is reported. Estimates suggest that present laser technology is adequate for accelerating fuel pellets to a velocity required for the fuelling of a demonstration thermonuclear reactor. The laser requirements are energies of tens of kJ, pulse widths of tens of microsec, intensities of about 1 GX/sq cm focused over a 10-cm pellet trajectory, and a repetition rate of tens of Hz. SCS

A78-53696 Photocurrent loss within the depletion region of polycrystalline solar cells. M. A. Green (New South Wales, University, Kensington, Australia). *Solid-State Electronics*, vol. 21, Sept. 1978, p. 1139-1144. 7 refs.

The collection efficiency of carriers optically generated within the depletion region of polycrystalline solar cells is analyzed. The extent of the low collection efficiency region surrounding grain boundaries is shown to be very much smaller in the depletion layer than in the bulk quasi-neutral regions of the cells. For the optimum case where the grain boundaries are perpendicular to the edges of the depletion layer, it is shown that, near the center of the layer, the low collection efficiency area extends only a fraction of an extrinsic Debye length from the grain boundary. (Author)

A78-53804 # Calculation of the electromagnet for a high-speed magnetic-levitation surface transportation system (Raschet elektromagnitna sistemy magnitnogo podvesa dlia vysokoskorostnogo nazemnogo transporta /VSNT/). B V Lobov, V Ia Pali, A G Nikitenko, V P Grinchenkov (Novocherkasskii Politekhnikheskii Institut, Novocherkassk, USSR), and V I Bocharov (Vsesoiuznyi Elektrotekhnikheskii Nauchno-Issledovatel'skii Institut, Moscow, USSR) *Elektromekhanika*, July 1978, p 712-717 In Russian

The paper discusses the calculation and optimization of magnets for a maglev transportation system. The optimality criterion is the maximum ratio of electromagnetic force to gravity force acting on the portion of the magnet suspended to the rail, for given values of air gap, pole width, and coil length, the ratio of electromagnetic force to consumed power is also taken into account. B.J

A78-53807 Energy reeds and the environment. S. Bjork and W. Graneli (Lund, Universitet, Lund, Sweden) *Ambio*, vol. 7, no. 4, 1978, p. 150-156. 25 refs

The cultivation of reeds (Phragmites) in Sweden as a source of heating fuel is considered. Ecology, environmental modification, harvesting, energy output, and costs are discussed. It is suggested that it is economically advantageous to preserve wetland areas for reed growth, and that the preservation, enlargement, management, and utilization of wetlands would supply several gains in terms of environmental protection. The storage of water to keep the water level high during the period of rapid growth, the attractiveness of the pond environment for birds and roe deer, and the retardation of pond ageing are considered. M.L.

A78-53817 Solar generators and their possibilities (Solar-generatoren und ihre Moglichkeiten). E. Sommer (Fachbeirat Laser-Optoelektronik, Bonn, West Germany) *Sonnenenergie*, vol. 3, July-Aug. 1978, p. 19-21. In German

Terms used to describe solar cells and solar generator systems are defined, and solar energy applications which do not require large amounts of energy are surveyed. (Examples include providing power for telephone centers in remote areas and warning lights for aircraft.) The present capabilities of solar generators which produce less than 100 kW is examined with reference to alternate energy sources and technical and economic limitations. The future role of solar energy is considered. M.L.

A78-53818 The cost/effectiveness of future solar electricity generation (Die Wirtschaftlichkeit künftiger solarer Stromerzeugung). H. Seitz *Sonnenenergie*, vol. 3, July-Aug. 1978, p. 23, 24. 9 refs. In German

The cost of solar electricity generation from a system of solar cells and wind converters is estimated and compared to the costs of generating and transporting energy produced by nuclear energy or by coal. Durability, fuel costs, and power-heat coupling are examined. The increase in energy use in West Germany by the year 2000 is considered, and the proportion of this demand that could be satisfied by solar energy is estimated. M.L.

A78-53819 Energy considerations in the operation of solar installations (Energiebetrachtungen zur Steuerung von Solaranlagen). K. Schwarz *Sonnenenergie*, vol. 3, July-Aug. 1978, p. 26, 28-30. In German

Equations relating various parameters of solar collectors are introduced, and several examples of their application are presented. Topics considered include the amount of useful energy derived from a collector, the control of energy transport, energy storage, and the operation of a collector in conjunction with a storage system. The numerical examples involve problems such as the calculation of usable energy obtained at different temperatures. M.L.

A78-53863 Short-term storage and wind power availability. M. B. Anderson, K. Newton, M. Ryle, and P. F. Scott (Cambridge University, Cambridge, England) *Nature*, vol. 275, Oct. 5, 1978, p. 432-434. 6 refs. Research supported by the Science Research Council and Royal Commission for the Exhibition of 1851.

Hourly wind and temperature measurements over a 17-yr period were used to investigate the feasibility of a simple system in which wind power is used in conjunction with 150-hour thermal storage for providing domestic space heating for the U.K. The model system consists of connected turbines providing the sole means of heating for three groups of houses, each house being equipped with a thermal store having a half-power decay time of 150 hours. It was found that the temperature in the houses is kept within 3°C of the nominal temperature of 20°C for 86% of the time. It is shown that use of too high a rated speed (wind speed at which turbine produces peak output) leads to large fluctuations in available power and could result in more expensive design of turbine for a given annual energy output. P.T.H.

A78-53916 # Development of a combustion chamber for an experimental MHD generator (Razrabotka kamery sgoraniia opyt-nogo MGD generatora) Ia S. Zhuludov (Akademiia Nauk Ukrainskoi SSR, Institut Elektrodinamiki, Kiev, Ukrainian SSR) *Teploenergetika*, Aug. 1978, p. 45-48. 8 refs. In Russian

The requirement placed on the combustion chamber of an MHD generator operating with nonpreheated fuel are formulated. A combustion chamber designed for gaseous fuel, which meets the formulated requirements is described. Particular attention is given to design solutions leading to an ordered spatial structure of the flow and a drastic decrease in fluctuations. V.P.

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STAR ENTRIES

N78-28081# National Aviation Facilities Experimental Center., Atlantic City N J

TESTS OF CRASH-RESISTANT FUEL SYSTEM FOR GENERAL AVIATION Interim Report, Feb. 1976 - Jun. 1977

William M Perrella, Jr Mar 1978 32 p

(FAA Proj 184-521-100)

(AD-A054141 FAA-NA-77-48, FAA-RD-78-28) Avail NTIS HC A03/MF A01 CSCL 01/3

A significant percentage of general aviation aircraft accidents result in post-crash fires due to the ignition of fuel spillage, often contributing injury or death to the aircraft occupants. Testing was performed to demonstrate the performance of light-weight, flexible, crash-resistant fuel cells combined with the use of frangible fuel line couplings. Included in these tests were three full-scale crash tests of a typical light twin aircraft. In all of these tests, the crash-resistant fuel system performed satisfactorily.

Author

N78-28132*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
ENERGY CONSUMPTION PROGRAM. A COMPUTER MODEL SIMULATING ENERGY LOADS IN BUILDINGS

F W Stoller, F L Lansing, V W Chai, and S Higgins *In its*
The Deep Space Network 15 Jun 1978 p 288-289 refs

Avail NTIS HC A14/MF A01 CSCL 10B

The JPL energy consumption computer program developed as a useful tool in the on-going building modification studies in the DSN energy conservation project is described. The program simulates building heating and cooling loads and computes thermal and electric energy consumption and cost. The accuracy of computations are not sacrificed, however, since the results lie within + or - 10 percent margin compared to those read from energy meters. The program is carefully structured to reduce both user's time and running cost by asking minimum information from the user and reducing many internal time-consuming computational loops. Many unique features were added to handle two-level electronics control rooms not found in any other program.

J M S

N78-28149# Committee on Science and Technology (U S House)

SOLAR POWER SATELLITE

Washington GPO 1978 461 p refs. Hearings before Subcomm. on Space Sci. and Applications and the Subcomm. on Advanced Energy Technologies and Energy Conservation Res., Development and Demonstration of the Comm. on Sci. and Technol., 95th Congr., 2d Sess., No 68, 12-14 Apr 1978

(GPO-28-155) Avail Subcomm. on Space Sci. and Applications

Legislation to establish a program office within the Department of Energy for assigning roles to both NASA and DOE for determining the technical feasibility, economic viability, and social acceptability of satellite solar power transmission to earth is discussed. Cooperation between the two agencies is reviewed and the systems definition efforts being conducted at NASA centers are described by Deputy Administrator, Dr Alan Lovelace.

A R H

N78-28225*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio

EROSION /CORROSION OF TURBINE AIRFOIL MATERIALS IN THE HIGH-VELOCITY EFFLUENT OF A PRESSURIZED FLUIDIZED COAL COMBUSTOR

Glenn R Zellars, Anne P Rowe, and Carl E Lowell Jul 1978 33 p refs

(NASA-TP-1274 E-9507) Avail NTIS HC A03/MF A01 CSCL 11F

Four candidate turbine airfoil superalloys were exposed to the effluent of a pressurized fluidized bed with a solids loading of 2 to 4 g/scm for up to 100 hours at two gas velocities, 150 and 270 m/sec, and two temperatures, 730 deg and 795 C. Under these conditions, both erosion and corrosion occurred. The damaged specimens were examined by cross-section measurements, scanning electron and light microscopy, and X-ray analysis to evaluate the effects of temperature, velocity, particle loading, and alloy material. Results indicate that for a given solids loading the extent of erosion is primarily dependent on gas velocity. Corrosion occurred only at the higher temperature. There was little difference in the erosion/corrosion damage to the four alloys tested under these severe conditions.

G G

N78-28262# SRI International Corp., Menlo Park, Calif.
HOMOGENEOUS CATALYTIC HYDROCRACKING OF COAL TO LIQUID FUELS. BASIC AND PROCESSES FOR CONVERSION OF COAL TO LIQUID FUELS. BASIC AND EXPLORATORY RESEARCH Monthly Report, Sep 1977

3 Nov 1977 7 p

(Contract EX-76-C-01-2202)

(FE-2202-23, MR-23) Avail NTIS HC A02/MF A01

MeOH was found to be more effective than i-PrOH in the base-catalyzed cleavage of the model compound phenyl ether (Ph-o-Ph), and with much less alcohol condensation. Also, CO in the presence of H₂O and KOH effectively reduces coal in reactions at 400 C (753 F) for 20 min, providing about 20% hexane soluble and 50% benzene soluble products, with the remainder being pyridine soluble. The interaction of Illinois No 6 (PSOC-25) coal with a 50/50 mixture of tetralin and decane and also with dihydronaphthalene were determined at 400 C. Coal treated with the tetralin decane mixture yielded products about half as soluble in pyridine as those obtained with pure tetralin. Under the same conditions dihydronaphthalene was superior to Tetralin for coal solubilization at 400 C and reaction times up to 4 min. Illinois No 6 coal from Franklin County was treated with tetralin at 400 C for reaction times from 30 sec to 4 min.

ERA

N78-28263# Department of Energy, Washington, D C Div of Solar Energy
RESEARCH AND DEVELOPMENT FOR FUELS FROM WOODY BIOMASS Program Research and Development Announcement

14 Nov 1977 194 p

(TID-28024, ET-78-D-01-4126)

Avail NTIS

HC A09/MF A01

A program is summarized which develops biomass resources to produce clean fuels, petrochemical substitutes, and other energy incentive products. These products will supplement similar products made from conventional fossil fuels. All forms of plant materials, those grown on land and in water were considered. Forest and crop residues, crops grown for their energy content, and animal manures were also considered. Research and development in the following areas were conducted: (1) growing biomass, (2) harvesting, collection, transporting, and storing biomass, and (3) converting biomass.

Author (ERA)

N78-28290 British Library Lending Div., Boston Spa (England)
MODEM POWER INSTALLATIONS FOR TELECOMMUNICATIONS

J Maitre 20 Jul 1977 18 p Transl into ENGLISH from L'Echo des Rech (France), no 86, Oct 1976 p 14-23

(BLL-Trans-3501-(7737470)) Avail British Library Lending Div., Boston Spa, Engl

After first demonstrating the need for power installations, the author traces the technical and economic criteria which have dictated their construction in their most modern form. He discusses the design problems encountered and explains how they may be solved. He goes on to describe their probable development.

Author

N78-28369 Miami Univ. Coral Gables, Fla.
THREE DIMENSIONAL FREE SURFACE MODEL FOR THERMAL DISCHARGE STUDY Ph.D. Thesis

Ching-fen Tsai 1977 211 p

Avail. Univ. Microfilms Order No. 78-08254

The rapid growth both in electrical energy demand and in the unit size of thermal power plants has resulted in an increasing concern with the effects of heated water on the environment. The analysis of thermal discharges with the least possible environmental impact and with an increase in cooling efficiency has become an important part of power plant siting evaluation. The set of governing equations for mass, momentum, and energy were solved simultaneously by using the finite difference approximation method. Both surface and submerged types of discharge systems in an estuary and ocean coast were modeled with various environmental conditions. The results from the model were satisfactorily compared both with airborne I-R data and in-situ field measurements. When applying the model to a specific site, only the initial conditions, boundary conditions, and the bottom topography need to be modified.

Dissert. Abstr.

N78-28454 Cornell Univ., Ithaca, N.Y.
AN EXPERIMENTAL STUDY OF RECIPROCATING INTERNAL COMBUSTION ENGINES OPERATED ON HYDROGEN Ph.D. Thesis

Howard Stokes Homan 1978 220 p

Avail. Univ. Microfilms Order No. 7809490

In order to determine the potential of direct cylinder injection for hydrogen-fueled engines, power output, thermal efficiency, and oxides of nitrogen emissions were measured for cooperative fuel research engine configurations having the standard Otto head, the standard Diesel head, and a Diesel head modified to simulate the combustion chamber of D399 series Caterpillar diesel engines. Reciprocating internal combustion engines can be operated on hydrogen using direct cylinder injection starting late in the compression stroke. This mode of operation provides control over the rate of combustion, offers a solution to fundamental engine problems such as knock, rough running due to high rates of pressure rise, and to high amplitude pressure waves in the cylinder.

Dissert. Abstr.

N78-28466* General Motors Corp., Indianapolis, Ind. Detroit Diesel Allison Div.

STUDY AND PROGRAM PLAN FOR IMPROVED HEAVY DUTY GAS TURBINE ENGINE CERAMIC COMPONENT DEVELOPMENT Final Report

H. E. Helms May 1977 156 p refs

(Contract EX-76-A-31-1011, NAS3-20064)

(NASA-CR-135230, CONS/0064-1, DDA-EDR-9068) Avail. NTIS HC A08/MF A01 CSCL 21A

A fuel economy of 213 mg/W h (0.35 lb/hp-hr) brake specific fuel consumption by 1981 through use of ceramic materials, with conformance to current and projected Federal noise and emission standards was demonstrated and a commercially viable engine is described. Study results show that increased turbine inlet and regenerator inlet temperatures, through the use of ceramic materials, contribute the greatest amount to achieving fuel economy goals. Further, improved component efficiencies for the compressor, gasifier turbine, power turbine, and regenerator disks show significant additional gains in fuel economy. Fuel saved in a 500,000 mile engine life, risk levels involved in development, and engine related life cycle costs for fleets (100 units) of trucks and buses were used as criteria to select work goals for the planned program.

ERA

N78-28467# Sandia Labs., Albuquerque, N. Mex.
CRASH TESTING OF NUCLEAR FUEL SHIPPING CONTAINERS

R. M. Jefferson and H. R. Yoshimura Dec 1977 50 p refs (Contract EY-76-C-04-0789)

(SAND-77-1462) Avail. NTIS HC A03/MF A01

In an attempt to understand the dynamics of extra severe transportation accidents and to evaluate state-of-the-art computational techniques for predicting the dynamic response of shipping casks involved in vehicular system crashes, a program was initiated to investigate these areas. Computational methods for predicting the effects of the accident environment were utilized and the damage incurred by a container as the result of such an accident was calculated. The second phase involves the testing of 1/8 scale models of transportation systems. Through the use of instrumentation and high-speed motion photography, the accident environments and physical damage mechanisms were studied in detail. After correlating the results of these first two phases, a full scale event involving representative hardware was conducted. Results indicate that both computational techniques and scale modeling are viable engineering approaches to studying accident environments and physical damage to shipping casks.

ERA

N78-28468# Pratt and Whitney Aircraft, West Palm Beach, Fla. Government Products Div.

ADVANCED INDUSTRIAL GAS TURBINE TECHNOLOGY READINESS DEMONSTRATION PROGRAM PHASE 1: DESIGN STUDY Final Report

J. K. Schweitzer and B. T. Brown Oct 1977 220 p

(Contract EY-76-C-05-5035)

(HCP/T5035-1) Avail. NTIS HC A10/MF A01

Design optimization studies and resulting conceptual engine definition of an advanced industrial gas turbine in the 15,000 shp/10Mw class are presented along with the detail aerodynamic and mechanical design of the 18:1 pressure ratio axial/centrifugal compressor and 2500 F combustor exit temperature (CET) turbine first vane and blade critical component test rigs. The design approach was to combine advanced aircraft turbine cooling and high pressure compressor technology with the requirements of simplicity and rugged construction for industrial engines to achieve increased efficiency, improved durability, fuel flexibility, fewer number of parts, and hence, lower initial and operating costs as compared to current industrial gas turbines. Cycle studies indicate that a specific fuel consumption at ISO conditions of 0.37 is attainable.

ERA

N78-28501# World Meteorological Organization, Geneva (Switzerland)

SOLAR ENERGY

1977 709 p refs. Proc. of the UNESCO/WMO Symp., Geneva, 30 Aug - 3 Sep 1976

(WMO-477, ISBN-92-63-10477-8) Avail. NTIS HC A99/MF A01

Selected papers on solar energy are discussed. They include monitoring solar radiation for solar energy, solar radiation on inclined surfaces, meteorological data in different regions, measurement and evaluation of radiation data, planning and coordination, general aspects of utilization of solar energy and energy production, solar electricity, and fuel production.

N78-28502# National Oceanic and Atmospheric Administration, Silver Spring, Md.

MONITORING SOLAR RADIATION FOR SOLAR ENERGY

Lester Machta /in WMO Solar Energy 1977 p 1-35 refs

(Grant NSF AFR-75-17303)

Avail. NTIS HC A99/MF A01

Requirements for solar energy monitoring are reviewed. These include instruments, type of users, accuracy and network requirements, insolation data requirements, and scientific requirements for solar radiation data related to a comprehensive solar energy program. A method is suggested which corrects

past insolation data. This method compares actual observations for clear solar noon with those estimated from other observations or from theory. Global solar radiation estimates are derived using sunshine or cloud information either through regression analysis or from theoretical calculations. The need for providing users with data on solar radiation falling on inclined surface, requiring the separation of direct and diffuse components from the global solar radiation is emphasized. ESA

N78-28511# World Meteorological Organization, Geneva (Switzerland)

FIRST RESULTS OBTAINED FROM THE SWISS MOBILE SYSTEM FOR SOLAR RADIATION MEASUREMENTS

A. Heimo and P. Valko. *In its* Solar Energy 1977 p 144-152 refs

Avail NTIS HC A99/MF A01

An autocar, equipped with a number of different radiation measuring instruments was set in operation at various locations in Switzerland during the last two years. By using seven pyranometers movable with step-motors in any position this mobile system permits the determination of global radiation falling on arbitrarily orientated and inclined plane surfaces. The direct solar radiation on a normal surface was measured in the total spectrum, the three broad spectral ranges of the Schott filters OG1, RG2, and RG3 and also at 12 quasi-monochromatic wavelengths. Terrain properties and cloudiness distribution were recorded by a 180 deg (fish-eye)-camera. By these means also the diffuse radiation flux on 77 differently orientated and tilted planes was determined in several hundred cases for each plane. The dependence of the global and diffuse radiation intensities on solar height, atmospheric turbidity, cloudiness, terrain characteristics and on the orientation and inclination of the plane are discussed. Instruments for determining the intensity distribution of the radiation density over the sky hemisphere in the total spectrum as well as for spectral scanning in the sun's vertical to get the polarization parameters of sky radiation, are under construction. Author (ESA)

N78-28519# United Nations Environment Program
SOLAR ENERGY APPLICATIONS FOR THE ARID AREAS

Bertrand Chatel. *In WMO Solar Energy* 1977 p 219-225

Avail NTIS HC A99/MF A01

In April 1975, an inter-agency fact-finding mission visited some of the Sahelian countries to collect facts about possible applications of solar energy to solve the most urgent problems of drought stricken countries such as Senegal, Gambia, Mauritania, Upper Volta, Mali, and Niger. The mission found that useful applications could be developed, notably for pumping underground water and generating small outputs of electric power for villages. Other useful devices would include water heaters to replace the present burning of scarce wood for cooking, solar distillers, food dryers, and refrigeration equipment for food conservation and the cooling of buildings. The grinding of cereals by solar electricity would be a particularly useful labor-saving equipment. The Advisory Committee on the Application of Science and Technology to Development has urged the use of nonconventional sources of energy (solar, wind, and biological energy conversion) for many applications in developing countries. Author (ESA)

N78-28520# World Meteorological Organization, Geneva (Switzerland)

SOLAR ENERGY RESEARCH AND DEVELOPMENT IN INDIA

A. Ramachandran. *In its* Solar Energy 1977 p 226-232

Avail NTIS HC A99/MF A01

Areas of utilization of solar energy and wind power in India can be divided into the following different categories: rural sector, urban sector, and special applications such as salt production, metallurgical furnaces, and milk and paper industries, desalinated

process water supply to coastal industries, etc. For this purpose a national energy research committee was constituted and a national integrated program drawn up. The various aspects of this program include solar insolation mapping, solar thermal devices and wind mills and photovoltaic conversion. Special mention is made of two other major projects: (1) the solar space heating and (2) the 10 kW solar power plant. ESA

N78-28521# Bandung Inst of Technology (Indonesia)

FRAMEWORK FOR A SOLAR ENERGY RESEARCH AND DEVELOPMENT POLICY PROPOSED FOR INDONESIA AND ITS RELEVANCE TO SOLAR ENERGY UTILIZATION IN BUILDING SYSTEMS

Iskandar Danusugondho and Aldy Anwar. *In WMO Solar Energy* 1977 p 223-251 refs

Avail NTIS HC A99/MF A01

A framework for a comprehensive and long-range national policy for the development of solar energy utilization in Indonesia is proposed, introducing a fresh approach and a new orientation into solar energy research, development, and education based on a broad concept of solar energy utilization. An initial study to apply this concept and an approach to develop solar energy utilization in building systems is currently under way at the Bandung Institute of Technology. This program is briefly outlined. Author (ESA)

N78-28522# Mali National Solar Energy Lab., Bamako (West Africa)

DEVELOPMENT AND USE OF SOLAR ENERGY IN MALI

Cheichne Traore. *In WMO Solar Energy* 1977 p 252-258

Avail NTIS HC A99/MF A01

Activities concentrated mainly on studying means of using solar radiation without prior conversion are presented. They include a program on water heating, industrial heating, solar distillation and steam production, solar drying, solar cookers, and solar pumps. Existing facilities required to carry out the various programs are briefly cited and future requirements mentioned. ESA

N78-28523# World Meteorological Organization, Geneva (Switzerland)

A BRIEF REVIEW OF THE UNITED STATES SOLAR RESOURCE ASSESSMENT PROGRAM

Michael R. Riches. *In its* Solar Energy 1977 p 259-261

Avail NTIS HC A99/MF A01

The U.S. insolation resource assessment program is briefly outlined including user requirements, data format, data networks, and data estimation. ESA

N78-28524# World Meteorological Organization, Geneva (Switzerland)

NATIONAL SOLAR PROGRAM FOR RESEARCH AND DEVELOPMENT IN ARGENTINA

R. Fernandez L. Saravia, and W. Scheuer. *In its* Solar Energy 1977 p 263-271 refs

Avail NTIS HC A99/MF A01

A national program for research and development in solar energy, to coordinate the activities of 22 groups belonging to universities, institutes, and federal agencies, and to cover three main areas: (1) conversion to thermal energy (applications to buildings, industry, and agriculture), (2) conversion to other forms of energy (electricity, gas, etc.), and (3) related studies (solar climatology, national solar data center, transfer to industry, socio-economical studies, etc.) is presented. The state-of-the-art in Argentina is briefly described with references to climatological conditions, social needs, and results so far obtained, including their regional implementation. Author (ESA)

N78-28525# World Meteorological Organization, Geneva (Switzerland)

UTILIZATION OF SOLAR ENERGY IN BRAZIL

Antonio M A MacDowell *In its Solar Energy* 1977 p 272-277

Avail NTIS HC A99/MF A01

The research program on the use of solar energy in Brazil has been guided mainly towards application in the fields of collectors, dryers, stills, refrigeration, heat engines, solar architecture, photovoltaic effect, thermo-mechanical conversion, storage, bioconversion, concentrators, wind energy, and solar-metry Projects are briefly outlined
ESA

N78-28526# University of the West Indies, Saint Augustine (Trinidad)

SOLAR ENERGY UTILIZATION IN THE WEST INDIES

S Satcunanathan *In WMO Solar Energy* 1977 p 278-291
refs

Avail NTIS HC A99/MF A01

Agriculture forms the basis of the economy of most of the twelve territories that comprise the CARICOM states of the Caribbean, contributing between 25% and 40% of the GDP and accounting for between 20% and 50% of the labor force Tourism forms the mainstay in some of the territories and contributes significantly to the national economies in several others Solar energy utilization in crop drying, water heating, desalination, and refrigeration could therefore be of considerable benefit to these territories The solar energy research and development work carried out in the region in several relevant areas is reviewed
Author (ESA)

N78-28528# Pahlavi Univ, Shiraz (Iran) Solar Energy Center

SOLAR ENERGY UTILIZATION RESEARCH IN IRAN

Mehdi N Bahadori *In WMO Solar Energy* 1977 p 309-327
refs

Avail NTIS HC A99/MF A01

The solar energy research activities of several universities in Iran up to June 1975 are briefly described The activities at Pahlavi University in Shiraz include the development of solar air heaters, water heaters, steam cookers, dehydrators desalinators, sterilizers, and power production and a feasibility study of solar house heating in Iran The solar research at the Arya-Mehr University of Technology include the development of solar desalinators and inexpensive production of Cd-S solar cells The solar research activities of the University of Tehran, College of Science and Technology, and the University of Azarabadegan are in their beginning stages and limited to the thermal applications of solar energy
Author (ESA)

N78-28529# National Research Centre, Cairo (Egypt)

ASPECTS OF SOLAR ENERGY RESEARCH IN EGYPT

I A Sakr *In WMO Solar Energy* 1977 p 328-341

Avail NTIS HC A99/MF A01

A series of investigations and studies utilizing the solar energy in different fields and including both engineering and economical evaluations were carried out The program started with the thermal utilization of solar energy in different domains including solar water heating for domestic purposes, water desalination, refrigeration, cooking, and power generation
ESA

N78-28530# World Meteorological Organization, Geneva (Switzerland)

STATUS OF SOLAR ENERGY PROJECTS IN THE FEDERAL REPUBLIC OF GERMANY

F J Friedrich and H Klein *In its Solar Energy* 1977 p 342-350
refs

Avail NTIS HC A99/MF A01

In early 1974 the Federal Government initiated its Energy Research and Development Program for non-nuclear sources of energy aiming at reduction of dependence on oil imports and the long-term security of a wide range of energy supplies Within this program solar energy research for both solar-thermal and photo-voltaic conversion is subsidized In the field of solar-thermal conversion, a technological gap existed Industry was first provided with the necessary funds to accumulate the required know-how The second phase - which is now under way - is characterized

by demonstration projects and preparation for quantity production processes In a few years, complete solar hot water systems will be economically feasible For the time being solar-electric conversion based on thermodynamic cycles is essentially cheaper than direct conversion by photovoltaic cells Small solar power stations in the 10 kW level were to be available in 1977 Improved production processes for silicon photo cells, as well as alternative material combinations, are under investigation, the aim being to achieve a substantial price reduction Together with research on fuel production, these projects can have a significant economical impact by the end of the century
Author (ESA)

N78-28531# Pahlavi Univ, Shiraz (Iran) Solar Energy Center

INTERNATIONAL COORDINATION AND PLANNING FOR A MORE EFFECTIVE UTILIZATION OF SOLAR ENERGY

Mehdi Nejad Bahadori *In WMO Solar Energy* 1977 p 351-356

Avail NTIS HC A99/MF A01

Measures are suggested for global planning for more effective solar energy utilization including more efficient energy conversion or energy conservation It is shown that by effective global planning it is possible to make better use of available energy resources and to improve the quality of the environment, thus using solar energy more effectively to meet the energy requirements of the world
ESA

N78-28532# State Univ of New York, Albany

SOLAR ENERGY DEVELOPMENT AND IMPLEMENTATION

Ronald Stewart and Volker A Mohnen *In WMO Solar Energy* 1977 p 357-371
refs

Avail NTIS HC A99/MF A01

The Atmospheric Sciences Research Center and its professional staff received a special appropriation in 1974 from the Legislature of the State of New York to prepare options for the implementation of solar energy concepts These included interaction with government, educational institutions and industry, research, development, and demonstration and position papers on energy policy A statewide network for incoming solar radiation was established Data analysis included hourly means and the monthly variation of hourly means, daily means and running means of three and five day periods, and monthly means with yearly variation of monthly means Administrative results and research problems associated with the continued operation of the network are discussed Projects for conversion of solar radiation for heating and cooling purposes are presented
Author (ESA)

N78-28533# World Meteorological Organization, Geneva (Switzerland)

SOLAR HOUSES A GENERAL APPRAISAL OF SOLAR BUILDING DESIGN AND TECHNOLOGY

C N D Stambolis *In its Solar Energy* 1977 p 372-414
refs

Avail NTIS HC A99/MF A01

An overall appraisal of solar heated and cooled buildings in the world today is given A study, undertaken by the author on behalf of UNESCO aimed at analyzing and comparing comprehensively in terms of construction and performance, a number of successful solar buildings is presented A brief historical introduction to the concept of using the sun's energy directly for heating buildings is made and the basic types of solar buildings are described and classified Solar components and systems currently in use are discussed and the level of technological involvement present in the various types of solar building referred to is assessed Selected examples of solar buildings are analyzed in terms of their location, construction, solar system, design and performance and climatic adaption Tables are presented comparing the above factors for various solar buildings and some conclusions are drawn as to the size of components used and the suitability of particular building designs for different climatic zones The economics of solar building and the prospects which lie ahead for further research, development and applications in this field are explored
Author (ESA)

N78-28534# Copenhagen Univ (Denmark)
SOLAR HEAT SYSTEMS FOR USE AT HIGH LATITUDES

Bent Soerensen *In* WMO Solar Energy 1977 p 415-421
 refs

Avail NTIS HC A99/MF A01

Factors such as the relative importance of the solar collector area, absorber efficiency, heat and reflection losses, concentrating collectors, and the nature and size of the storage facility of a solar heat system to be used in polar regions were investigated for various modes of operation. The economic justifications for adding the cost of a heat pump to the system are discussed.

ESA

N78-28535# Genoa Univ (Italy)
SOLAR ENERGY AND LIMITS TO THE ENERGY ON THE EARTH

G Francia *In* WMO Solar Energy 1977 p 422-430

Avail NTIS HC A99/MF A01

The consequences that man-produced energy might have on the planet's temperature were examined. It is shown that the production of energy on the earth's surface is considerably altering the thermal equilibrium at the earth surface and therefore modifying the climate in a dramatic way. The use of solar energy is recommended.

ESA

N78-28536# Akademiya Nauk URSR, Kiev
INFLUENCE OF SOLAR RADIATION AND RADIANT HEAT FLOW MEASUREMENT ERROR ON MEASUREMENT ACCURACY OF MATERIAL PHYSICAL CHARACTERISTICS IN SOLAR FURNACES

I N Frantsevitch, V S Dvernyakov, and V V Pasichny *In* WMO Solar Energy 1977 p 431-437 refs

Avail NTIS HC A99/MF A01

A solar furnace complex the Academy of Sciences of the Ukraine was used for the study of physical, mechanical, optical as well as some thermo-physical and physico-chemical properties of materials in temperature range from 180 C to 3500 K. The influence of solar radiation and heat flow measurement error at the focal spot on the physical properties are investigated. It is shown that based on an army searchlight with a 2 meter mirror, the measurement error of heat flows in the focal spot of a typical laboratory furnace is up to 15% to 20%. The calculation was carried out taking into account the guidance accuracy of the mirror, normal solar radiation measurements, the pattern position selected in relation to the focal spot, the accuracy of the calorimeter and measurement devices used, and other factors. In particular experimental data variability caused by the non-uniform structure of materials often surpasses measurement errors. While studying material and coating radiative characteristics that undergo phase transformation over a given temperature range, the experimental data variability also surpasses measurement error because of the surface instability. Some considerations on ways of reducing measurement error and on the influence on accuracy of atmosphere phenomenon experiments that change the radiation spectrum but are not recorded by the usual laboratory actinometer AT-50.

Author (ESA)

N78-28537# Centre National d'Etudes Spatiales, Toulouse (France)

INTEGRATION OF INFRA-RED AMBIENT TEMPERATURE AND WIND CONDITIONS IN FLAT COLLECTOR PERFORMANCE PREDICTION

R Ployart, J Colomes, and B Devin *In* WMO Solar Energy 1977 p 438-449 refs

Avail NTIS HC A99/MF A01

The performance prediction of flat plate solar collectors is dependent on solar incidence angle, global radiation, and environmental conditions which determine the losses of the device. Extensive collector testing on solar simulator and curve fitting with physical models has shown the necessity to have infrared

radiation collector performance at any location. Pyrradiometers can be used for infrared measurements, but it has been shown that a more simple method could be used at weather stations to derive a figure representative of ambient conditions for flat plate collectors. This is a stagnation temperature of a specific glass window which integrates the influence of infrared, wind, and ambient temperature. Justification and use of this environment equivalent temperature in collector performance is given and the measuring device described.

Author (ESA)

N78-28538# Building Research Establishment Watford (England)

SOLAR ENERGY APPLICATIONS IN UK BUILDINGS

R G Courtney *In* WMO Solar Energy 1977 p 450-458 refs

Avail NTIS HC A99/MF A01

Recent studies have shown that 40% to 50% of the UK energy consumption is used in buildings for heating, lighting, etc. Solar energy could assist in the provision of space and water heating and in the long term potentially cut energy consumption by 10% to 20%. The main characteristics of solar radiation in the UK are: (1) a high proportion (more than 50%) of diffuse radiation and (2) a large annual variation (10% to 1) in the energy received each month. These characteristics cause problems in the utilization of solar energy in buildings which are discussed. The economics of solar water heating - for which a small market exists in the UK - are briefly discussed and experimental projects in the use of solar energy for water and space heating purposes are described. These include: a water heating system in a school and three houses which have installed 40 sq m of collector panels, 20 sq m of collector panels and 36 cu m of hot water storage, and a solar air heat and heat pump. The latter two houses are under construction. Prospects for the widespread use of solar energy in UK buildings are discussed.

Author (ESA)

N78-28543# World Meteorological Organization Geneva (Switzerland)

DESIGN AND ECONOMY OF SOLAR POWER PLANTS WITH INTEGRATED THERMAL ENERGY STORAGE

P V Gilli and G Beckmann *In* WMO Solar Energy 1977 p 498-506 refs

Avail NTIS HC A99/MF A01

Due to discrepancies of electric supply and demand patterns in solar steam power plants, energy storage - either integrated thermal energy storage (before generator) pumped hydro storage (after generator, before meter), or storage at the customer (after meter) - is required. Steam storage requires pressure vessels and is limited in temperature, but oil or fused salt are more expensive and require heat transfer equipment - and a temperature differential - for charging and discharging. It is claimed that the new technology of the Prestressed Cast Iron Pressure Vessel (PCIV) has shifted the economic balance in favor of steam storage, because due to the character of the PCIV cost function, higher pressures have become economically interesting and much larger units (of, for instance, 8000 cu m at a pressure of 60 bar) can be built. The PCIV leads to the development of new flow sheets for the integration of the thermal storage system into the plant. PCIV steam accumulators of the pressure-drop type and of the new expansion-type with flash evaporators are investigated. There is also a limited possibility for utilizing feed water storage. Cost data presented show that integrated steam storage by means of PCIV of the types considered is an attractive possibility for balancing electric supply and demand and thus for maximum utilization of insolation in solar steam power plants.

Author (ESA)

N78-28544# Rome Univ (Italy)

SOLAR DESALINATION STATUS AND POTENTIAL

Carlo Mustacchi and Vincenzo Cena *In* WMO Solar Energy 1977 p 507-518 refs

Avail NTIS HC A99/MF A01

Freshwater can be produced by means of solar energy at a cost of 1 to 17 \$/cu m with a margin of the order of 5% towards fossil-fired operation. This concerns plants having a nominal production of at least 50 cu m/hr and the multistage flash evaporator concept. For much smaller capacities, basin stills, at a cost of 2 \$/cu m, are a convenient low-technology solution. These margins will increase to 30% within the next ten years, and can even lead to better prospects provided that priority is given to the present bottlenecks of this technology, namely, increasing lifetime and reliability, designing an appropriate heat storage system, improving the dynamics of startup and shutdown for the plants. Author (ESA)

N78-28545 Centre National d'Etudes Spatiales, Paris (France)
SOLAR ELECTRICITY
W. Palz. In: WMO Solar Energy 1977. p. 519-538

Avail. NTIS HC A99/MF A01

The possibility of direct solar energy to displace part of the conventional fossil prime energy which serves to generate the remainder of the electricity is emphasized. Potential conversion processes for solar electricity generation are reviewed, including solar cells and mechanical conversion by engines. Photovoltaic solar generator performance is discussed. It is concluded that current and future development programs on solar electricity should be planned as an integrated effort on various related problems, particularly in the areas of energy storage and meteorological data collection. ESA

N78-28546# College of Petroleum and Minerals, Dhahran (Saudi Arabia)
DIRECT CONVERSION OF SOLAR ENERGY INTO ELECTRICITY
M. Ali Kettani. In: WMO Solar Energy 1977. p. 539-549. refs

Avail. NTIS HC A99/MF A01

Possibilities of conversion of solar energy into electricity are considered namely: direct conversion, conversion through heat stage, conversion through a mechanical stage, and through a chemical stage. Four methods are discussed: the photovoltaic conversion, photoemissive conversion, photogalvanic conversion, and photomagnetic conversion. A material surface could absorb as much as 95 percent of solar energy and convert it into heat. The difference between input heat and the rejected heat could be converted into electricity directly or indirectly. In the direct case, thermo-electricity and thermionic processes are used. In the indirect case, heat engines and regenerative fuel cells can be considered. Solar energy can first be converted into mechanical or hydraulic energy before being converted into electricity. It can also be converted into chemical or biological energy or any other form. These different possibilities are analyzed and their potentialities discussed. Author (ESA)

N78-28549# World Meteorological Organization, Geneva (Switzerland)
STATUS REPORT ON THE DEVELOPMENT OF TERRESTRIAL SOLAR GENERATORS
E. F. Schmidt. In: WMO Solar Energy 1977. p. 570-580

Avail. NTIS HC A99/MF A01

The goal of utilization of solar energy as a competitive power source to cover considerable portions of power demand can only be met if the cost expenditure for solar-electric devices is kept to a minimum. When designing power supply systems, the following sub-system areas have to be considered: (1) development of low cost Si-base material, (2) development of technologies for manufacturing solar cells from different new types of base material, (3) development of low-cost generator modules by integrating solar cells mechanically and electrically, and (4) development and/or stimulation of development of electronic power conditioning and energy storage sub-systems. The market for terrestrial solar generators is surveyed. To study long-term environmental effects a solar generator of 1 kW is being manufactured and a test program is being carried out. The planned activities in development of terrestrial solar generators are surveyed. Author (ESA)

N78-28550# World Meteorological Organization, Geneva (Switzerland)
PROSPECTS OF POWER GENERATION FROM SOLAR PLANTS IN THE NORTH EAST OF BRAZIL
L. S. Cheema, Cleantho da Camara Torres, and Pío Caetano Lobo. In: WMO Solar Energy 1977. p. 581-590. refs

Avail. NTIS HC A99/MF A01

The prospects for the utilization of solar power plants in the north east of Brazil are studied for small communities removed from the power grid. The number of units that would be economically feasible depends on the price of plant per unit of installed capacity and the possibility of energy storage and subsidiary functions (distillation pumping) performed by the plant. Some solutions that may reduce the cost of plant and price targets that appear to be viable in the near future are considered. The most interesting applications of solar power plant lie in the low capacity range (up to 10 kW). This position derives from the fact that solar power cost per unit installed capacity is practically independent of unit size. Whereas in conventional plants the economics of scale apply, i.e. cost per unit installed capacity falls as the capacity of the plant increases. Based on the electricity power grid in the north east of Brazil, the maximum demand for small solar power plants given two different selling prices per unit of installed capacity is estimated. Areas in the north east of Brazil where the installation of solar power plants is considered possible are indicated. Author (ESA)

N78-28552# World Meteorological Organization, Geneva (Switzerland)
SMALL SCALE ELECTRIC POWER GENERATION BY MEANS OF A STATIONARY SPHERICAL REFLECTOR/TRACKING ABSORBER (SRTA) SOLAR COLLECTOR SYSTEM IN DEVELOPING COUNTRIES
F. Kreigh and J. F. Kreider. In: WMO Solar Energy 1977. p. 600-610. refs

Avail. NTIS HC A99/MF A01

The possibility of using large scale Spherical Reflector/Tracking Absorber (SRTA) solar collectors for generating electrical power in various parts of the world is investigated, with particular emphasis on developing countries. Large SRTA reflectors can be built with medium technology by using an approach similar to that employed in the construction of the 305 meter-diameter Arecibo Observatory in Puerto Rico. To test the proposed concept, an eight foot model of a stationary SRTA solar collector was built and the efficiency of the collector absorber system was determined experimentally at the NASA Goddard Space Flight Center. The collector is described, the experimentally measured thermal performance is compared with analytical predictions based on a simplified model and the experimental results of the scale model are extrapolated to the performance of a 10 and a 100 megawatt solar electrical power generation system. Several methods of construction for the large scale unit are proposed and possible combinations of the solar power plant with an oil or coal fired backup and a hydroelectric power station are described. Finally, estimates of the cost of solar electric power derived from an SRTA solar steam generator are presented for various parts of the world based on available solar insolation data. Author (ESA)

N78-28553# World Meteorological Organization, Geneva (Switzerland)
REALIZATION AND TESTING OF A PUMPING SYSTEM POWERED BY SOLAR CELLS
D. Campana, A. Castiel, A. Perez, J. A. Roger, C. Dupuy, P. Lavit, and M. Lepert. In: WMO Solar Energy 1977. p. 611-620

Avail. NTIS HC A99/MF A01

The possibilities for powering isolated pumping systems by solar energy are studied. Such systems would be suitable for example for providing water to remote farms or high-mountain sheep folds for irrigation of these remote lands and in general should be of interest in regions where electrical power transmission or transport of fuel oil is difficult or too expensive. Moreover, application in developed countries could avert pollution where it is a recognized problem. The study is based on an

average farm in Corsica and includes the following aspects: determination of the solar flux at the earth's surface based on meteorological data (statistics during four year) and the design of panels, determination of the mounting of the panels (total surface area, orientation, grouping, etc.), choice of a direct-current motor and pump to be operated directly by the panels according to the requirements of the well, tests of the assembly as a function of orientation of the panels and comparisons with theoretical models. Various possibilities for improving the system are discussed. Author (ESA)

N78-28554# World Meteorological Organization, Geneva (Switzerland)

THE THERMODYNAMICS OF SOLAR ENERGY CONVERSION

Gerd Blaesser. *In its Solar Energy* 1977 p 622-630 refs

Avail NTIS HC A99/MF A01

A unified thermodynamical description of converting systems for the utilization of solar energy is given. It is shown that the free energy function can be written approximately as the sum of two terms, of which the first, the spectral term, depends on the matching of the converter to the sun's spectrum, while the second, the concentration term, contains the effects of the concentration of the radiation by means of mirrors, etc. Theoretical (thermodynamical) efficiencies for some typical systems are derived within the frame of this general formalism and discussed as examples. Author (ESA)

N78-28555# Wien Univ (Austria)

PHOTOCHEMICAL HYDROGEN PRODUCTION THROUGH SOLAR RADIATION BY MEANS OF THE MEMBRANE PRINCIPLE

E Broda. *In WMO Solar Energy* 1977 p 631-637 refs

Avail NTIS HC A99/MF A01

Nuclear experts are considering a hydrogen economy where H_2 serves as a fuel to make electricity, as a chemical reactant, as a metallurgical reductant and as a source of food. Now H_2 could also be made by photolysis of water. Theoretically, a quantum of green light carries enough energy for the reaction $H_2O = H_2 + 1/2 O_2$. With long-wave light, photolysis could be achieved by combination of 2 quanta. Yet attempts to photolyze water, in presence of sensitizers (photocatalysts), have failed. In the last analysis, this is due to re-combination of the primary, highly reactive, products of the photochemical reaction. A solution of the problem is to be found by the spatial separation of the primary products, i.e. by development of suitable membranes where these products, and therefore also the stable gases H_2 and O_2 , come out on opposite sides. The feasibility of this membrane principle has been shown in Nature for 3 giga-years. Using membranes, all photosynthetic cells (photosynthetic bacteria and plants) succeed in the photo-production of a reductant (in many cases at least ferredoxin in the reduced form) with a redox potential equal to that of H_2 in neutral solution (-0.4 V). The reductant can, but need not, be used by the cells for CO_2 assimilation. In man-made technology, the reducing power would be diverted as H_2 . It is not suggested to use or copy living cells. Rather, their operation is to be studied so that technically useful membranes for water photolysis can be constructed abiotically. The scientific and practical aspects of large-scale photolytic H_2 production are discussed. Author (ESA)

N78-28556# World Meteorological Organization, Geneva (Switzerland)

INVESTIGATIONS ON SEMICONDUCTOR/ELECTROLYTE SOLAR CELLS AND THE QUESTION OF THE PHOTO-ASSISTED WATER DECOMPOSITION

W Gissler. *In its Solar Energy* 1977 p 638-647 refs

Avail NTIS HC A99/MF A01

The photovoltaic effect at semiconductor/electrolyte interfaces can be exploited for the construction of solar cells. Possible advantages and problems of such solar cells are discussed. The cells can work in a self-regenerative mode of operation converting

solar energy in electrical energy, and/or they can convert solar energy in chemical energy decomposing the electrolyte or compounds dissolved in it. Most attractive is the photo-assisted water decomposition, the conditions for which will be discussed. To demonstrate the feasibility, cells with different semiconductor/electrolyte combinations have been constructed and tested. In spite of simple electrode preparation techniques and the use of polycrystalline material, large quantum efficiencies could be obtained (85% for the cell $TiO_2/0.1\text{ M Na}_2SO_4/Pt$). Losses during the charge transfer can lead to a considerable reduction of the expected energy efficiency. Water decomposition could not be effected even with large band gap semiconductors and at high light intensities because the obtained cell voltages were smaller than the water decomposition voltage. Applying to the solar cell the missing voltage photo-assisted electrolysis could be performed. This process might be more effective than the self-regenerative mode of operation. Author (ESA)

N78-28557# World Meteorological Organization, Geneva (Switzerland)

THE QUANTITATIVE EVALUATION OF WOOD AS A SOURCE OF SOLAR ENERGY

Waldo E Smith. *In its Solar Energy* 1977 p 648-654 refs

Avail NTIS HC A99/MF A01

The waste wood from U.S. forest harvests is substantial, and in the face of the rapid depletion of the world's fossil fuels should be developed as a renewable energy source. Also, consideration should be given to the development of energy farms on which plants of high energy production can be grown as an annual or periodic crop on lands now largely lying idle. It would appear that by intensive endeavor the energy equivalent of two or three percent of current petroleum use within five years and over a longer period, these sources may have the energy equivalence of 25 to 30 percent of U.S. current petroleum usage. The sources considered are as follows: (1) trimmings in the conversion of logs to lumber and timber for use; (2) small trees and branches, twigs, etc.; (3) use of wastes from paper pulp production; (4) improvements in forest management including genetic control, and development of energy farms. Author (ESA)

N78-28562 Colorado School of Mines, Golden

THE EVALUATION OF OIL FOAM FOR USE AS A DISPLACING MEDIUM FOR OIL RECOVERY IN POROUS MEDIA
Ph D. Thesis

Hazim Hassan Al-Attar 1976 143 p

Avail Univ Microfilms Order No 78-02792

The displacement of oil by externally generated foam was tested for three foam qualities under 15 psi imposed pressure differential. Test results showed that oil recoveries observed by oil foam displacement were appreciably higher than those observed by gas drive. Gravity effects increased oil recovery by as much as 19 percent over the horizontal test. The plastic viscosity of oil foam was measured for three foam quality ranges; using a capillary tube. Foam viscosity was found to increase as the quality increased. Oil foams expressed non-Newtonian behaviors but low values of yield stress. The existence of foam in the flow tests was determined by gas breakthrough time, relative permeability calculations and theoretically by capillary tube representation of the porous medium. The theoretical results matched the experimental results when oil foam displaced oil and when oil displaced water. However, the results showed a discrepancy when gas displaced oil. Dissert Abstr

N78-28573# Academy of Scientific Research and Technology, Cairo (Egypt)

LANDSAT SATELLITE MAPPING IN EGYPT AND ITS POSSIBLE APPLICATIONS IN PETROLEUM AND NATURAL GAS EXPLORATION

E M ElShazly and M A Abdel-Hady, Principal Investigators 1977 19 p refs. Presented at 10th Arab Petroleum Congr., Tripoli 19-25 Dec 1977. Sponsored by NASA ERTS

(E78-10168 NASA-CR-157286) Avail NTIS
HC A02/MF A01 CSCL 08B

N78-28586* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
A LIFE-CYCLE DESCRIPTION OF UNDERGROUND COAL MINING Interim Technical Report
Milton L. Lavin, Chester S. Borden, and John R. Duda 1 Jul 1978 102 p Prepared for DOE
(Contracts NAS7-100, ET-76-1-01-9036)
(NASA-CR-157346, JPL-Pub-78-26) Avail NTIS
HC A06/MF A01 CSCL 08I

An initial effort to relate the major technological and economic variables which impact conventional underground coal mining systems, in order to help identify promising areas for advanced mining technology is described. The point of departure is a series of investment analyses published by the United States Bureau of Mines, which provide both the analytical framework and guidance on a choice of variables. G Y

N78-28590* Battelle Pacific Northwest Labs., Richland, Wash.
DEVELOPMENT OF ELECTRICAL AND ELECTROCHEMICAL PROBES FOR DOWN HOLE AND IN-LINE CHEMICAL ANALYSIS OF HIGH PRESSURE, HIGH TEMPERATURE GEOTHERMAL FLUIDS Interim Report, period ending Oct 1977
M. J. Danielson, O. H. Koski, and D. W. Shannon Nov 1977 41 p refs
(Contract EY-76-C-06-1830)
(PNL-2459) Avail NTIS HC A03/MF A01

A high temperature-pressure, thermodynamic reference electrode was developed which was demonstrated to be operative in a simulated geothermal environment up to 250 C containing the contaminants that would affect its operation. An electrodeless conductivity probe was developed for use in the geothermal environment. The design is particularly resistant to the effects of scale deposition. The probe should be useful for measuring salinity, steam/brine ratios in two-phase flow, flashing point, and as a liquid-level control. A large number of sealing materials were investigated for use in the 250 C geothermal environment. The field test of the conductivity probe and reference electrode at East Mesa was a success. The conductivity probe successfully predicted the total dissolved solids content of the brine, and the redox probe data coupled with Pourbaix diagrams indicated FeS and FeS₂ as surface film present on the electrodes and test loop. Instantaneous corrosion rate methods were demonstrated to be easily set up and convenient to operate. ERA

N78-28591* Lockheed Missiles and Space Co., Palo Alto, Calif.
Research Lab
DEVELOPMENT OF COATINGS FOR CORROSION/EROSION PROTECTION OF INTERNAL COMPONENTS OF COAL GASIFICATION VESSELS Monthly Report, 1-31 Jan. 1978
C. M. Packer and R. A. Perkins 8 Feb 1978 12 p
(Contract EF-77-C-01-2592)
(FE-2592-4) Avail NTIS HC A02/MF A01

The conclusion can be reached that these preliminary exploratory studies with both slurry and plasma/flame coatings indicate that laser surface fusion is useful in the deposition of corrosion/erosion coatings. This is supported by responses to initial inquiries regarding the state of laser technology and its applicability to this type of surface heat treatment. Further experimental work, literature reviews, and industry surveys are necessary. Nevertheless, it appears that sound coatings with controlled compositions can be produced effectively and economically. Furthermore, the process lends itself to self-repair and it appears that the current state-of-the-art will permit scaleup to large components. The program plan originally included an evaluation of slurry fusion techniques for the deposition of coatings as well as plasma and flame spray approaches. ERA

N78-28595 Tennessee Univ., Knoxville
ON THE ECONOMIC OPTIMIZATION OF THE MAGNETO-HYDRODYNAMIC-STEAM POWER PLANT Ph D Thesis
James Nolen Chapman 1977 148 p
Avail Univ. Microfilms Order No. 7807683

A model of the entire plant is constructed such that, given a triple of input conditions: combustor pressure, air pre-heat temperature, and magnetic field strength, the thermodynamic properties, flow rates, and performance of the plant are calculated. Cost Estimating Relationships are developed so that capital costs can be estimated from the plant calculation. Then using a set of typical financial assumptions, the cost of electricity (COE) is calculated. With this model, COE is calculated for a variety of operating conditions. The conditions that give minimum COE are found. Based upon these conditions, a MHD generator is designed and the plant performance calculated for this optimum case. Finally, the sensitivity of the resulting optimum plant to variations in seed flow rate, coal price, and heat loss in the combustor is calculated. Dissert. Abstr.

N78-28597* Aerospace Corp., El Segundo, Calif.
Systems Engineering Operations
ADVANCED SPACE POWER REQUIREMENTS AND TECHNIQUES TASK 1 MISSION PROJECTIONS AND REQUIREMENTS VOLUME 1 TECHNICAL REPORT
Malcolm G. Wolfe 1 Mar 1978 207 p refs
(Contract NASw-3078)
(NASA-CR-157344, ATR-78(7667)-1-Vol-1) Avail NTIS
HC A10/MF A01 CSCL 10B

The objectives of this study were to: (1) develop projections of the NASA DoD and civil space power requirements for the 1980-1995 time period; (2) identify specific areas of application and space power subsystem type needs for each prospective user; (3) document the supporting and historical base, including relevant cost-related measures of performance; and (4) quantify the benefits of specific technology projection advancements. The initial scope of the study included: (1) construction of likely models for NASA DoD and civil space systems; (2) generation of a number of future scenarios; (3) extraction of time-phased technology requirements based on the scenarios; and (4) cost/benefit analyses of some of the technologies identified. G Y

N78-28598* RCA Labs., Princeton, N. J.
AUTOMATED ARRAY ASSEMBLY Final Report
R. V. Daiello Dec 1977 163 p Prepared for DOE and JPL
(Contract NAS7-100 JPL-954352)
(NASA-CR-157317, DOE/JPL-954352-77/4, PRRL-77-CR-54)
Avail NTIS HC A09/MF A01 CSCL 10A

A general technology assessment and manufacturing cost analysis was presented. A near-term (1982) factory design is described, and the results of an experimental production study for the large-scale production of flat-panel silicon and solar-cell arrays are detailed. G G

N78-28602* Sensor Technology Inc., Chatsworth, Calif.
THE 40 kW OF SOLAR CELL MODULES FOR THE LARGE SCALE PRODUCTION TASK A LOW COST SILICON SOLAR ARRAY PROJECT Final Technical Report
Gregory T. Jones Dec 1977 38 p refs Sponsored by DOE
Prepared for JPL

(Contract NAS7-100)
(NASA-CR-157348, DOE/JPL-95465-77/1) Avail NTIS
HC A03/MF A01 CSCL 10A

Forty kilowatts of solar cell modules was produced in this program. This is equivalent to 4123 modules. The average power output per module was 9.7 watts at 16.5 volts, 60 C and 100 mW/sq cm. The peak production rate was 200 modules per week, which is equal to 1.9 kW per week. This rate was sustained for over four and one-half months and is equivalent to 100 kW per year. This final report covers the solar cell module design, electrical and power performance, module preproduction, environmental test results, production and shipping schedule.

program summary and delivery. A cost analysis section is written. Particular emphasis on the percentage of labor and material utilized in constructing a solar cell module is presented. Also included are cost reduction recommendations. Author

N78-28607*# National Aeronautics and Space Administration
Lewis Research Center Cleveland, Ohio
**AN IMPROVED METHOD FOR ANALYSIS OF HYDROXIDE
AND CARBONATE IN ALKALINE ELECTROLYTES CON-
TAINING ZINC**

Margaret A Reid 1978 14 p refs To be presented at the
154th meeting of the Electrochem Soc Inc, Pittsburgh,
15-20 Oct 1978
(NASA-TM-78961) Avail NTIS HC A02/MF A01 CSCL 10C

A simplified method for titration of carbonate and hydroxide
in alkaline battery electrolyte is presented involving a saturated
KSCN solution as a complexing agent for zinc. Both hydroxide
and carbonate can be determined in one titration, and the
complexing reagent is readily prepared. Since the pH at the end
point is shifted from 8.3 to 7.9 - 8.0 m-cresol purple or phenol
red are used as indicators rather than phenolphthalein. Bromocresol
green is recommended for determination of the second end point
of a pH of 4.3 to 4.4. Author

N78-28608*# AiResearch Mfg Co Torrance Calif
**PRELIMINARY DESIGN STUDY OF AN ALTERNATE HEAT
SOURCE ASSEMBLY FOR A BRAYTON ISOTOPE POWER
SYSTEM Final Report, Oct 1977 - Apr 1978**

Hal J Strumpf May 1978 112 p refs Prepared for JPL
(Contract NAS3-20816)
(NASA-CR-135428 AiResearch-78-15171) Avail NTIS
HC A06/MF A01 CSCL 10A

Results are presented for a study of the preliminary design
of an alternate heat source assembly (HSA) intended for use in
the Brayton isotope power system (BIPS). The BIPS converts
thermal energy emitted by a radioactive heat source into electrical
energy by means of a closed Brayton cycle. A heat source heat
exchanger configuration was selected and optimized. The design
consists of a 10 turn helically wound Hastelloy X tube. Thermal
analyses were performed for various operating conditions to ensure
that post impact containment shell (PICS) temperatures remain
within specified limits. These limits are essentially satisfied for
all modes of operation except for the emergency cooling system
for which the PICS temperatures are too high. Neon was found
to be the best choice for a fill gas for auxiliary cooling system
operation. Low cycle fatigue life, natural frequency and dynamic
loading requirements can be met with minor modifications to
the existing HSA. B B

N78-28609*# Copper Development Association Inc, New York
N Y
**COLLATION OF MONTHLY AND SEMIANNUAL REPORTS
COVERING INSTRUMENTATION AT THE DECADE 80
HOUSE IN TUCSON, ARIZONA**

Jun 1978 24 p Prepared for DOE
(Contract NAS8-32244)
(NASA-CR-150728) Avail NTIS HC A02/MF A01 CSCL
10B

The Decade 80 solar house, located in Tucson, Arizona was
built to show the use of copper in home building and to
demonstrate the use of solar energy to provide space heating
and cooling and domestic hot water. The auxiliary energy sources
are electrical resistance heating for the domestic hot water and
a gas fired boiler for space heating and operation of the absorption
air conditioning units. The Semi-Annual report gives an over-
view of the instrumentation effort with the back-up monthly
reports reflecting more detail of the effort that went into the
implementation of the data acquisition system. G Y

N78-28610*# Moseley (Terrell E.), Inc Lynchburg, Va
**SOLAR HEATING SYSTEM INSTALLED AT LYNCHBURG,
VIRGINIA**

1 Dec 1976 174 p
(Contract E(49-18)-2388)
(NASA-CR-150729) Avail NTIS HC A08/MF A01 CSCL
10B

A solar space and domestic hot water preheating system
was designed and installed in a retrofitted 1780 sq ft office
building. The 400 sq ft water cooled flat plate collector is mounted
facing south at a 50 deg slope on the flat roof of an adjoining
warehouse which shelters a 2 000 gal insulated steel tank with
a Bitumastic interior lining. In addition to the collector and the
tank, the system comprises a gas auxiliary boiler, a duct
distribution system utilizing a hot water duct coil and water-to-
air heat pump, and a hot water preheater. The system is fully
automatic. Installation, operation and maintenance instructions
are included. A R H

N78-28611*# Copper Development Association, Inc, New York,
N Y

**DESIGN PACKAGE FOR INSTRUMENTATION OF THE
DECADE 80 HOUSE IN TUCSON, ARIZONA**

Jul 1978 58 p Prepared for DOE
(Contract NAS8-32244)
(NASA-CR-150730) Avail NTIS HC A04/MF A01 CSCL
10A

A design package covering instrumentation and system design
for the Decade 80 House in Tucson, Arizona is presented. The
solar house is instrumented for the purpose of gathering data
to determine the solar heating and cooling system performance.
The use of copper in the construction of the house is a first
choice construction material because it conducts heat and resists
corrosion better than other materials and therefore provides a
more efficient and economical system. Equipment and site
specifications are reported, along with floor plans showing the
location of the site instrumentation hardware. G Y

N78-28612*# Honeywell, Inc, Minneapolis, Minn
**SOLAR HEATING AND COOLING SYSTEMS DESIGN AND
DEVELOPMENT Quarterly Report, 1 Jan. - 31 Mar 1978**

Jul 1978 20 p Prepared for DOE
(Contract NAS8-32093)
(NASA-CR-150732) Avail NTIS HC A02/MF A01 CSCL
10A

The development and delivery of eight prototype solar heating
and cooling systems for installation and operational test are
outlined for single-family residences, and commercial applica-
tions. G G

N78-28613*# General Electric Co, Philadelphia Pa
**SOLAR HEATING AND COOLING SYSTEM DESIGN AND
DEVELOPMENT Status Summary through Dec. 1977**

6 Apr 1978 26 p Prepared for DOE
(Contract NAS8-32092)
(NASA-CR-150735) Avail NTIS HC A03/MF A01 CSCL
10A

Application surveys and performance studies were conducted
to determine a solar heating and hot water configuration that
could be used in a variety of applications, and to identify subsystem
modules that could be utilized in a building block fashion to
adapt hardware items to single and multi-family residential and
commercial systems. Topics discussed include subsystem
development for the solar collectors, controls, other components,
energy management module and the heating system configuration
test. Operational tests conducted at an Illinois farmhouse, and a
YWCA in Spokane, Washington are discussed. A R H

N78-28614*# National Aeronautics and Space Administration
Lewis Research Center Cleveland, Ohio
**COMPARISON OF THREE EXPERIMENTAL METHODS
USED IN DETERMINING THE THERMAL PERFORMANCE
OF FLAT-PLATE SOLAR COLLECTORS Ph D Thesis - Kansas
Univ**

Gregory B Hotchkiss Oct 1978 289 p refs
(NASA-TM-78929 E-9669) Avail NTIS HC A13/MF A01
CSCL 10A

Three experimental methods for evaluating the thermal
performance of flat-plate solar collectors are presented. The
methods are classified according to the nature of the ambient
conditions encountered during experimental testing. The classifica-

tions are (1) steady state (2) quasi-steady state and (3) unsteady state. Experimental tests on two solar collectors were conducted in an indoor solar simulator and also out-of-doors. From the experimental collector data collector efficiency factors, which describe the steady state behavior of a collector, were determined for each experimental method. A parameter identification method based upon a discrete gradient optimization technique was used to determine the collector parameters from unsteady state data. Such a method would allow on-line data reduction and would enable speedy determination of the collector efficiency factors from transient data. The design, construction and operation of the test rig which was used to obtain the experimental data are also described. Author

N78-28615*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
EMERGING ENERGY ALTERNATIVES FOR THE SOUTHEASTERN STATES

Elias K Stefanakos, ed. 1978. 149 p. refs. Proc of Symp held at North Carolina A and T State Univ. Greensboro, 31 Mar 1978, sponsored by DOE and North Carolina A and T State Univ. (NASA-CP-2042, L-12251). Avail NTIS HC A07/MF A01 CSCL 10A

The proceedings of the first symposium on emerging energy alternatives for the Southeastern States are presented. Some topics discussed are (1) solar energy, (2) wood energy, (3) novel energy sources, (4) agricultural and industrial process heat, (5) waste utilization, (6) energy conservation and (7) ocean thermal energy conversion.

N78-28616*# Tennessee Technological Univ. Cookeville

AN OVERVIEW OF THE ENERGY SITUATION

Donald R Pitts. In NASA Langley Res Center. Emerging Energy Alternatives for the Southeastern States. 1978. p. 7-18.

Avail NTIS HC A07/MF A01 CSCL 10A

Beginning with a historical review of the domestic pattern of energy usage, the current dependence of the United States upon dwindling petroleum resources is examined. The possible limit of petroleum usage is discussed, and recent oil production trends are presented. Coupling these with projected analyses of OPEC oil productive capability in the early 1980's indicates a serious worldwide as well as American energy problem in the next decade. The need for conservation and rapid development of application of alternative energy resources is discussed including quantitative projections of significant conservation efforts as well as estimates of domestic alternative energy resource capabilities. LS

N78-28617*# Sandia Labs. Albuquerque N. Mex.

ALTERNATIVES IN SOLAR ENERGY

Donald G Schuele. In NASA Langley Res Center. Emerging Energy Alternatives for the Southeastern States. 1978. p. 19-25. refs. Sponsored by DOE.

Avail NTIS HC A07/MF A01 CSCL 10A

Although solar energy has the potential of providing a significant source of clean and renewable energy for a variety of applications, it is expected to penetrate the nation's energy economy very slowly. The alternative solar energy technologies which employ direct collection and conversion of solar radiation are briefly described. Author

N78-28618*# Ultrasytems, Inc. Washington D. C.

WOOD ENERGY-COMMERCIAL APPLICATIONS

Robert P Kennel. In NASA Langley Res Center. Emerging Energy Alternatives for the Southeastern States. 1978. p. 27-38. refs.

Avail NTIS HC A07/MF A01 CSCL 10A

Wood energy is being widely investigated in many areas of the country because of the many obvious benefits of wood fuel such as the low price per million Btus relative to coal, oil, and

gas, the wide availability of noncommercial wood and the proven ability to harvest it, established technology which is reliable and free of pollution, renewable resources, better conservation for harvested land, and the potential for jobs creation. The Southeastern United States has a specific leadership role in wood energy based on its established forest products industry experience and the potential application of wood energy to other industries and institutions. Significant questions about the widespread usage of wood energy are being answered in demonstrations around the country as well as the Southeast in areas of wood storage and bulk handling, high capitalization costs for harvesting and combustion equipment, long term supply and demand contracts, and the economic feasibility of wood energy outside the forest products industry. Author

N78-28619*# Old Dominion Univ. Norfolk, Va.
IMPACT OF NOVEL ENERGY SOURCES: OTEC, WIND, GEOTHERMAL, BIOMASS

A Sidney Roberts, Jr. In NASA Langley Res Center. Emerging Energy Alternatives for the Southeastern States. 1978. p. 39-57. refs.

Avail NTIS HC A07/MF A01 CSCL 10A

Alternate energy conversion methods such as ocean thermal energy conversion (OTEC), wind power, geothermal wells and biomass conversion are being explored, and re-examined in some cases, for commercial viability. At a time when United States fossil fuel and uranium resources are found to be insufficient to supply national needs into the twenty-first century, it is essential to broaden the base of feasible energy conversion technologies. The motivations for development of these four alternative energy forms are established. Primary technical aspects of OTEC, wind, geothermal and biomass energy conversion systems are described along with a discussion of relative advantages and disadvantages of the concepts. Finally, the sentiment is voiced that each of the four systems should be developed to the prototype stage and employed in the region of the country and in the sector of economy which is complementary to the form of system output. Author

N78-28620*# Department of Energy, Washington, D. C. Office of Solar Applications

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

James Dollard. In NASA Langley Res Center. Emerging Energy Alternatives for the Southeastern States. 1978. p. 59-86. refs.

Avail NTIS HC A07/MF A01 CSCL 10A

The application of solar energy to agricultural and industrial process heat requirements is discussed. This energy end use sector has been the largest and it appears that solar energy can, when fully developed and commercialized, displace from three to eight or more quads of oil and natural gas in U.S. industry. This potential for fossil fuel displacement in the agricultural and industrial process heat area sector represents a possible savings of 1.4 to 3.8 million barrels of oil daily. LS

N78-28621*# Department of Energy, Washington, D. C.
CONSERVATION AS AN ALTERNATIVE ENERGY SOURCE

Donald E Allen. In NASA Langley Res Center. Emerging Energy Alternatives for the Southeastern States. 1978. p. 87-94.

Avail NTIS HC A07/MF A01 CSCL 10A

A speech is given outlining the energy situation in the United States. It is warned that the existing energy situation cannot prevail and the time is fast running out for continued growth or even maintenance of present levels. Energy conservation measures are given as an aid to decrease U.S. energy consumption, which would allow more time to develop alternative sources of energy. LS

N78-28622*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va.

THE IMPACT OF MUNICIPAL REFUSE UTILIZATION ON ENERGY AND OUR ENVIRONMENT

In its Emerging Energy Alternatives for the Southeastern States. 1978. p. 95-116.

Avail NTIS HC A07/MF A01 CSCL 10A

The incinerator/boiler configuration is stressed as the most reliable method of waste utilization. It is also pointed out that the high cost of refuse disposal and the ever increasing cost of energy, have made this method attractive. A plan is outlined for operating a waste utilization plant. Community participation is encouraged in investigating the feasibility of refuse to energy facilities in their area. LS

N78-28623*# Oak Ridge Associated Universities, Tenn

HOW MUCH ENERGY DOES ENERGY COST?

Warren D Devine, Jr /n NASA Langley Res Center Emerging Energy Alternatives for the Southeastern States 1978 p 117-134 refs

Avail NTIS HC A07/MF A01 CSDL 10A

Estimating the energy cost of producing and delivering an energy product involves the quantitative determination of all relevant energy flows and the aggregation of these flows into meaningful indices of system performance. Five emerging energy technologies are subjected to energy analysis. The energy delivered by each is substantially greater than the energy consumed during construction and lifelong operation of the system. Net energy analysis can provide interesting and perhaps useful information regarding specific technologies, but it does not necessarily provide additional information essential to the making of decisions regarding those technologies. LS

N78-28626*# National Aeronautics and Space Administration Pasadena Office, Calif

METHOD OF FABRICATING A PHOTOVOLTAIC OF A SUBSTANTIALLY TRANSPARENT CONSTRUCTION Patent Application

Paul A Dillard (Lockheed Missile and Space Co., Inc., Sunnyvale, Calif.), Walter M Fritz (Lockheed Missile and Space Co., Inc., Sunnyvale, Calif.), and Dan R Lott, inventors (to NASA) (Lockheed Missile and Space Co., Inc., Sunnyvale, Calif.) Filed 26 Jul 1978 12 p

(Contracts NAS7-100)

(NASA-Case-NPO-14303-1, NASA-Case-NPO-14305-1,

US-Patent-Appl-SN-928133) Avail NTIS HC A02/MF A01 CSDL 10A

A method of fabricating a photovoltaic module transparent to all energy not used by the cells to produce electricity was examined. The method is characterized by the steps of registering a plurality of uniformly dimensioned photovoltaic cells of circular configurations, with a plurality of circular openings formed in a planar tool for affording access to the P contact surface of each of the cells. The N contact surface of alternate cells was connected to the P contact surface of the cells interposed between, removing residue from solder flux. NASA

N78-28628# Battelle Pacific Northwest Labs Richland, Wash
SUMMARY OF THE DEVELOPMENT PLAN FOR THE WIND CHARACTERISTICS PROGRAM ELEMENT OF THE FEDERAL WIND ENERGY PROGRAM

C E Elderkin and L L Wendell Oct 1977 53 p refs
(Contract EY-76-C-06-1830)

(PNL-2501) Avail NTIS HC A04/MF A01

The Wind Systems Branch (WSB) of the Solar-Technology Division of DOE is responsible for the FWEP and has divided the program into several program elements. The focus of this report is on the development of the Wind Characteristics Program Element (WCPE). The development plan presented contains a detailed breakdown of the proposed program for FY 1978 and a program overview and projection through FY 1980. The basic document provides a basis for communication between the WSB and the WCPE and will be continually updated as required to accomplish the overall objectives of the FWEP. This summary document is aimed at apprising the participant and user communities of the aims and priorities of the WCPE. ERA

N78-28630# Fluor Engineers and Constructors, Inc Irvine, Calif
ECONOMIC STUDIES OF COAL GASIFICATION: COMBINED CYCLE SYSTEMS FOR ELECTRIC POWER GENERATION Final Report

K Chandra, B McElmurry, E W Neben, and G E Pack Jan 1978 459 p refs Sponsored by EPRI
(EPRI Proj 239)

(EPRI-AF-642) Avail NTIS HC A20/MF A01

The objective was to identify whether significant economic and/or environmental incentives exist for using such systems compared to the current practice of direct coal firing and stack gas cleanup. The processes studied included the Lurgi dry ash gasifier, the British Gas Corporation slagler and three entrained-bed processes. All these processes were integrated with combined-cycle plants based on advanced gas turbine technology (2,400 F combustion outlet) estimated to be available in the 1981-1985 time period. The evaluations were based on complete grass-roots facilities sized to conform to the present electric utility practice of building units of approximately 1,000-MW capacity. It is concluded that several of the processes considered are potentially attractive and are or can be, available for commercialization during the next decade. ERA

N78-28633# Brookhaven National Lab Upton, N Y

UTILIZATION OF ENERGY INFORMATION REQUIREMENTS FOR POLICY

Kenneth C Hoffman Nov 1977 32 p refs Presented at the Workshop on Energy Inform., Stanford, Calif., 15-16 Dec 1977 (Contract EY-76-C-02-0016)

(BNL-23643, Conf-771226-1) Avail NTIS HC A03/MF A01

An integrated approach involving the use of aggregated energy-economic data, as well as more detailed data at the activity level involving the characterization of specific energy utilization processes in the residential, commercial and industrial sectors is outlined. Such information goes beyond the traditional treatment of resources utilization and delivered fuels to incorporate the concepts of energy services delivered and of the direct plus indirect energy content of goods and services that are consumed. The present situation is, therefore one of transition from a period where analysis was governed by the availability of data to one where information must be developed to support the needs of policy analysis. The current information base is summarized and recommendations are made for the future development of an information base and analytical capability that will support energy-utilization policy analysis. ERA

N78-28635# Georgetown Univ Washington, D C

GEORGETOWN UNIVERSITY COAL USING-INTEGRATED COMMUNITY ENERGY SYSTEM (GU/CU-ICES) DEMONSTRATION PROJECT. PHASE 1 DETAILED WORK MANAGEMENT PLAN Final Report, Aug 1977, - Jan 1978

31 Jan 1978 167 p refs

(Contract EC-77-C-02-4488)

(COO-4488-1) Avail NTIS HC A08/MF A01

The energy conservation potential of a heat and power generating system using a coal-fired atmospheric pressure fluidized bed combustor to supply all energy needs to operate the university buildings was studied. A prefeasibility study determined a group of ten subsystems that were directly related to the goals of the program. These included cogeneration from a steam turbine grid connection, diesel cogeneration, desiccant regeneration in HVAC dehumidification, heat pumping to a higher temperature, seasonal energy storage, cool storage of thermal energy, heat storage, coal and limestone storage and transportation and the combustor solid waste disposal. The goals and the subsystem alternatives, a comprehensive scope of work, detailed task plan, schedules and a management plan are defined. ERA

N78-28636# Oak Ridge National Lab, Tenn

COMMERCIAL ENERGY USE A DISAGGREGATION BY FUEL, BUILDING TYPE, AND END USE

Jerry R Jackson and William S Johnson Feb 1978 94 p

(Contract W-7405-eng-26)

(ORNL/CON-14) Avail NTIS HC A05/MF A01

The development of detailed estimates of energy use in the commercial sector is described. The level of detail includes five end uses, four fuel types, and ten commercial subsectors. Energy use estimates for each of the 200 components are developed for the years 1965 to 1975. Trends in commercial energy use by fuel type and end use are presented, energy use estimates disaggregated by building type, fuel, and end use are presented for 1970 and 1975. The three distinct tasks required to develop these estimates are presented in detail. The first task includes reviewing, analyzing, and interpreting data on commercial energy use to reflect consistent commercial sector coverage. Floor space stock estimates are developed in the second task. In the third step, information on relative energy use by building type is synthesized from studies of individual buildings and is used, along with aggregate fuel and floor space estimates, to calculate detailed energy use by subsector and year. ERA

N78-28638# Massachusetts Inst of Tech, Cambridge Alfred P Sloan School of Management

CHOICES IN THE NEXT ENERGY AND SOCIAL REVOLUTION

Charles J Ryan 7 Jul 1977 28 p

(Contract EX-76-A-01-2195-028)

(TID-28197) Avail NTIS HC A03/MF A01

As fossil fuels the energy source of industrialization, are depleted, the world enters into the third most important energy and social revolution in the development of civilization. Natural and social systems operate under the same principles of energy management. The evolution of civilization over more than a million years can be seen as a successful quest to control greater amounts of energy through social organization in three different energy and social systems: hunting and gathering, agriculture, and fossil fuels. The energy perspective of the paper suggests the relationship between continuous growth and social discontinuity in U.S. history. The physical and social consequences of future energy alternatives are discussed in terms of an Orwellian, Jeffersonian, and Malthusian type future (The Third Revolution: Orwell, Jefferson, or Malthus). The paper concludes with an endorsement of solar energy as the alternative most likely to afford a stable future in a humanly organized environment. ERA

N78-28641# Wormser Scientific Corp., Stamford, Conn

SOLAR HOUSE HEATING SYSTEM USING REFLECTIVE PYRAMID OPTICAL CONDENSING SYSTEM Progress Report, 1 Jun - 31 Dec 1976

Jan 1978 83 p

(Contract EY-76-C-02-2769)

(COO-2769-5) Avail NTIS HC A05/MF A01

The prototype system previously built on Westover Road, Stamford, Connecticut, was upgraded, instrumented, and evaluated. It was found to perform essentially as expected, but the open construction was found to have problems. A fully enclosed model Pyramidal Optics house was built by Better Homes of Delaware near Rehoboth, Delaware. After a number of significant improvements were made in the optical concentrating system and the flat plate receiver assembly, the system was monitored throughout the winter of 1976/1977 and found to perform very well. The solar contribution to heating amounted to 70 percent during the severe winter months and is expected to exceed 80 percent throughout the year. The Pyramidal Optics system was found to have a number of economic and operational advantages. It is planned to evaluate additional systems in other locations and different climatic conditions. ERA

N78-28642# Stuttgart Univ (West Germany) Inst fuer Kernenergetik und Energiesysteme

HEAT STORE FOR SOLAR ENERGY UTILIZATION IN HEATING SYSTEMS AND WATER HEATING

A Abhat May 1977 25 p In GERMAN Presented at the Energy Policies Forum of the Landesregierung, Stuttgart, 9 May 1977

(IKE-5-206, Conf-770592-4) Avail NTIS HC A02/MF A01

After a survey of the main parameters for heat store construction, a new latent-heat store concept is described which takes account of the experience with stores in existing solar houses. The new concept is based on a modular construction. Each module has a finned heat pipe partitioned into 3 compartments (store space, heat source region, and heat sink region). The space between the fins is filled with a storage material which changes from the solid to the liquid phase when heat is added. The test model was operated with paraffin and wax ester. Finally, a proposal is made for an integration of the latent-heat store concept into a solar space and water heating system. ERA

N78-28644# Boeing Engineering and Construction, Seattle, Wash

CLOSED-CYCLE, HIGH-TEMPERATURE CENTRAL RECEIVER CONCEPT FOR SOLAR ELECTRIC POWER Final Report

Jan 1978 279 p refs

(EPRI Proj 377-1)

(EPRI-ER-629) Avail NTIS HC A13/MF A01

The technical feasibility of a high-temperature central receiver in a solar plant employing closed-cycle helium as a heat transport fluid was examined in terms of system life, efficiency, cost, and technology requirements. These considerations were implemented in the conceptual design of a receiver and its components for utilization in a solar plant of 100 megawatts of electrical power output. The rationale is provided that supports the configuration, equipment arrangement, and material choices. Thermal cycling tests simulating 30-year lifetime of the receiver's heat exchangers at temperatures to 816 C and at 500 psi helium pressure, confirmed material choices. Preliminary design considerations are presented for a 1 megawatt thermal test receiver and for a 10 megawatt electrical pilot plant. Also, a system/supporting-subsystem definition is presented for employing the central receiver design in a solar plant. This includes conceptual design of several thermal energy storage devices and their integration into plant operation. ERA

N78-28646# Massachusetts Inst of Tech, Cambridge Energy Lab

WASTE HEAT MANAGEMENT IN THE ELECTRIC POWER INDUSTRY ISSUE OF ENERGY CONSERVATION AND STATION OPERATION UNDER ENVIRONMENTAL CONSTRAINTS Progress Report, 1 Jun - 31 Dec 1977

Jan 1978 15 p ref

(Contract EY-76-S-02-4114)

(COO-4114-4) Avail NTIS HC A02/MF A01

Progress in identifying costs, and in particular operating costs, associated with the use of various cooling systems for reducing the thermal impact from base load steam electric power plants is reported. Costs for a single, hypothetical river site are compared. The essential methodology and preliminary results are summarized. A 1200 MWe nuclear plant and an 800 MWe fossil fuel plant were studied. Open cycle diffusers, cooling ponds, mechanical and natural draft evaporative towers and mechanical draft dry towers were considered for both plants. A set of models was developed to optimize the components of each cooling system based on the local meteorological and hydrological conditions at the site in accordance with a fixed demand, scalable plant concept. The concept allows one to compare the costs of producing the same net power from each plant/cooling system. ERA

N78-28647# Cornell Univ Ithaca N Y Coll of Agriculture and Life Sciences

ANAEROBIC FERMENTATION OF AGRICULTURAL RESIDUES. POTENTIAL FOR IMPROVEMENT AND IMPLEMENTATION Quarterly and Semiannual Progress Report, 16 Sep - 15 Dec 1977

W J Jewell, R W Guest, R C Loehr, D R Price W W Gunkel, and P J VanSoest 1977 45 p
(EY-76-S-02-2981)

(COO-2981-6, QR-6 SAPR-3) Avail NTIS HC A03/MF A01

The development of new and/or improved technology to facilitate and promote the widespread use of anaerobic fermentation in agriculture as a source of renewable, clean energy is outlined. Activities reported include completion of the final draft of the final report describing the findings of the first year of the project, excavation and site preparation, construction of the full scale plug flow and pilot scale random mixed fermentors, installation of the ram pump manure delivery system, construction of two buildings to house controls and appurtenances, and continued operation of the pilot scale plug flow fermentor. ERA

N78-28648# Illinois Univ., Urbana Dept. of Civil Engineering

BIOLOGICAL CONVERSION OF BIOMASS TO METHANE
Quarterly Progress Report, 1 Jun - 30 Sep 1977

J T Pfeffer Oct 1977 29 p

(Contract EY-76-S-02-2917)

(COO-2917-6) Avail NTIS HC A03/MF A01

Work on the use of beef feed lot manure for the production of methane was studied. Additional data were collected on the operation of the fermentors at thermophilic temperatures. Data were also collected at the mesophilic temperature. A considerable effort was expended on characterizing the reactor effluent and evaluating the dewatering characteristics of the reactor slurry. Evaluation of the type of reactor on methane yields were continued. Data were collected on these systems operating at a total retention time of 10 days. Response of the system and reaction rates were determined. ERA

N78-28649# Los Alamos Scientific Lab. N. Mex.

ELECTRICITY GENERATION AND STORAGE FOR RESIDENCES USING LI/12 ELECTROCHEMICAL ENGINES TO AUGMENT PHOTOVOLTAICS

G R B Elliot 1977 9 p Presented at Electrochem Soc Meeting, Atlanta, 9-15 Oct 1977

(Contract W-7405-eng-36)

(LA-UR-77-2330, Conf-771060)

Avail NTIS HC A02/MF A01

Electrochemical engines use electrochemical cell reactions and a temperature gradient to convert heat directly to electric power. Such engines can both generate electricity and store electric energy. Application of such engines as used with solar photovoltaic conversion is discussed. Specifically, it is shown that such engines could both store electric energy generated in daytime for nighttime use, and generate electric power from gas or other fossil heat in bad weather. If the photovoltaics remain expensive, the electrochemical engines themselves could be used to generate electric power from focused solar collection. ERA

N78-28652# California Univ., Livermore Lawrence Livermore Lab. Technology Applications Group

DEPARTMENT OF ENERGY'S SOLAR TECHNOLOGY TRANSFER PROGRAM

C F Miller 9 Jan 1978 5 p Presented at the 2d Natl Conf and Exhibition on Technol for Energy Conserv., Albuquerque, New Mex., 24-27 Jan 1978

(Contract W-7405-eng-48)

(UCRL-80431, Conf-780109-2)

Avail NTIS HC A02/MF A01

Outreach activities were conducted in approximately 30 states. Primary target audiences include such groups as architects, builders, lenders, contractors, plumbers, manufacturers, distributors as well as educational institutions state and local offices, and library systems. The outreach program is the only operational regionalized solar commercialization capability available to DOE on a nationwide basis at this time. ERA

N78-28653# Bechtel Corp., San Francisco Calif.

TECHNICAL AND ECONOMIC ASSESSMENT OF SOLAR DISTILLATION FOR LARGE SCALE PRODUCTION OF

FRESH WATER Final Report

Dec 1977 81 p refs

(Contract EY-76-C-04-0789)

(SAND-77-8176) Avail NTIS HC A05/MF A01

An assessment of solar distillation plant performance attainable with presently implementable technology is presented. A review of existing technology provides the basis for selection of the design for a 5 million gallon per day solar distillation plant. The cost of distilled water from this plant is compared with the cost of water from an oil fired distillation plant of the same installed capacity. For present day plant construction and annual fuel escalation rates below 10.5 percent, water obtained from a solar driven distillation plant is more expensive than that obtained from conventional oil driven distillers. ERA

N78-28654# California Univ. Berkeley Cooperative Extension Service

GOVERNMENTAL COSTS AND REVENUES ASSOCIATED WITH GEOTHERMAL ENERGY DEVELOPMENT IN IMPERIAL COUNTY

G Goldman and D Strong Oct 1977 80 p refs

(Contract W-7405-eng-48)

(UCRL-13800, Publ-13800) Avail NTIS HC A05/MF A01

The cost and revenue impacts to local governments of three geothermal energy growth scenarios in Imperial County were estimated. The level of geothermal energy potential for the three development scenarios tested is 2,000, 4,000 and 8,000 MW, enough power to serve 270,000 to 1,000,000 people. The analysis of the three growth scenarios tested indicates that county population would increase by 3.7 and 19 percent and assessed values would increase by 20, 60, and 165 percent for Alternatives No. 1, No. 2 and No. 3 respectively. Direct and indirect effects would increase new jobs in the county by 1,000, 3,000 and 8,000. Government revenues would tend to exceed public service costs for county and school districts, while city costs would tend to exceed revenues. In each of the alternatives, if county, cities and school districts are grouped together, the revenues exceed costs by an estimated \$1,600 per additional person either directly or indirectly related to geothermal energy development in the operational stages. ERA

N78-28655# California Univ., Livermore Lawrence Livermore Lab.

METHODOLOGY FOR ASSESSING THE POTENTIAL IMPACT ON AIR QUALITY RESULTING FROM GEOTHERMAL RESOURCE DEVELOPMENT IN THE IMPERIAL VALLEY

P H Gudiksen, M C Axelrod, D L Ermak, K C Lamson and R Lange 17 Oct 1977 17 p refs Presented at the Intern Clean Air Conf., Brisbane, Australia, 15-19 May 1978

(Contract W-7405-eng-48)

(UCRL-79388, Conf-780504-1)

Avail NTIS HC A02/MF A01

The installation of a network of air quality stations for characterizing the air quality and atmospheric transport properties in the valley prior to development is discussed. Analyses of geothermal fluids for various gases were performed to evaluate the potential emission rates from future geothermal power plants. The principal pollutant of concern was H₂S because of its noxious odor and potential release rate. These estimated source emission rates and the appropriate meteorological measurements were used as input to a three dimensional, atmospheric transport code to estimate the potential changes in air quality that result from various scenarios for development of geothermal power. ERA

N78-28657# General Electric Co., Philadelphia, Pa Space Div

APPLIED RESEARCH ON ENERGY STORAGE AND CONVERSION FOR PHOTOVOLTAIC AND WIND ENERGY SYSTEMS. VOLUME 3: WIND CONVERSION SYSTEMS WITH ENERGY STORAGE Final Report

27 Sep 1977 330 p refs Sponsored by DOE

(Grant NSF C-75-22221)

(TID-28287/3) Avail NTIS HC A15/MF A01

Wind energy conversion systems and their use of energy storage are studied by the assessment of selected candidate storage concepts, and by evaluation of the effects of selected parameters on the attractiveness and worth of energy storage utilization. The scope of the investigations included both utility and non-utility applications. In addition to establishing cost goals for storage, the impact of charging storage from multiple sources, as well as from wind systems alone, was included, along with the effects of wind forecasting and transient smoothing of the wind system output. ERA

N78-28658# Foster-Miller Associates, Inc., Waltham Mass
DEVELOPMENT OF A PASSIVE HEATING AND COOLING SYSTEM USING A PUMPED HEAT PIPE Quarterly Technical Progress Report, 6 Sep 1977 - 30 Nov. 1977

J T Dieckmann Dec 1977 8 p
 (Contract EG-77-C-04-4098)
 (TID-28188, QTPR) Avail NTIS HC A02/MF A01

The technical progress in the program versus schedule and budget is summarized. The efforts expended on each task are discussed briefly. Author (ERA)

N78-28661# Los Alamos Scientific Lab., N Mex
ECONOMICS OF THE ATTACHED SOLAR GREENHOUSE FOR HOME HEATING

C D Kolstad 1978 12 p refs Presented at the 2d Natl Conf and Exhibition on Technol for Energy Conserv., Albuquerque, New Mex., 23-27 Jan 1978
 (Contract EY-76-C-04-0789)
 (LA-UR-22, Conf-780109-5) Avail NTIS HC A02/MF A01

For several years, passive solar heating was considered to be very attractive for home heating in the U.S. Unfortunately passive systems are not as easily analyzed as active systems from an engineering and economic performance point of view. This problem is addressed, and an economic assessment of the solar greenhouse is given. Using simple heat balance analysis, a greenhouse performance model was developed for assessing heat available for home space conditioning from an add on solar greenhouse. This forms the basis for an engineering economic model for assessing the economic viability of the add on solar greenhouse for home heating. Model variables include climate factors, local costs, alternate fuels and system size. The model is then used to examine several locations in the U.S. for the economic attractiveness of the add on solar greenhouse for space heating. ERA

N78-28662# Sandia Labs., Albuquerque, N Mex
SOLAR IRRIGATION PROGRAM STATUS

R H Braasch and G E Brandvold 1978 9 p refs Presented at the Intern Solar Energy Congr., New Delhi, 16 Jan 1978
 (SAND-78-0398C, Conf-780114-3) Avail NTIS HC A02/MF A01

A program to develop solar energy as a practical power source for irrigation pumps is discussed briefly. Two experimental systems in operation or under development for developing system designs which are technically and economically feasible are described. One is near Willard New Mexico, and the other near Coolidge, Arizona. ERA

N78-28664# Sandia Labs., Albuquerque, N Mex
LASER RAY TRACE TESTER FOR PARABOLIC TROUGH SOLAR COLLECTORS

B D Hansche Jan 1978 18 p Presented at the 24th Intern Instrumentation Symp., Albuquerque New Mex., 1 May 1978
 (Contract EY-76-C-04-0789)
 (SAND-78-0012C, Conf-780503-7) Avail NTIS HC A02/MF A01

A laser ray trace tester is being developed to measure slope errors of parabolic trough solar collectors. The design parameters, current status of the device, and some improvements which are necessary are described. ERA

N78-28665# Sandia Labs., Albuquerque, N Mex Systems Analysis Div

SYSTEMS ANALYSES OF STORAGE IN SPECIFIC SOLAR THERMAL POWER APPLICATIONS

H M Dodd 1978 14 p refs Presented at the SERI Storage Applications Workshop, Golden, Colo., 14 Feb 1978
 (Contract EY-76-C-04-0789)
 (SAND-78-03424C, Conf-780216-1) Avail NTIS HC A02/MF A01

Several approaches are presented using optimization techniques plus an additional approach which attempts to discover generalized results concerning the appropriate sizes of solar collector and storage medium for a given load. The optimization techniques either have thermal storage built into the model or (in one case) have a general storage module which can be representative of thermal storage. Applications to solar irrigation and total energy are discussed. Author (ERA)

N78-28666# Illinois Univ., Urbana Dept of Civil Engineering

BIOLOGICAL CONVERSION OF BIOMASS TO METHANE

J T Pfeffer Jan 1978 6 p
 (Contract EY-76-S-02-2917)
 (COO-2917-7) Avail NTIS HG A02/MF A01

Complete-mix and multistage reactors are evaluated for use in the anaerobic fermentation of organic solids for methane production. Results indicate that if a balanced population of organisms is maintained in the initial stage, multi-stage fermentation is more efficient than a complete-mix system. However, if the system is stressed, failure of the multi-staged system is more rapid. When the first stage was not inhibited due to a short retention time, the waste stabilization in the additional stages was minimal. Further studies on the effect of retention time on reaction rates indicated that the type of reactor design desired depends upon the objective of the system. A staged system will produce more methane per unit volume of reactor for a given quantity of solid substrate. Maximal methane production, per unit volume is obtained by a single-stage reactor operating at near minimum retention. Results of studies on the fermentation of manures and corn stover are discussed briefly. ERA

N78-28667# Istituto Superiore di Sanita, Rome (Italy) Lab delle Radiazioni

SOME CONSIDERATIONS ON LONG TERM ENERGY PROSPECTS

G Campos Venuti, S Frullani, E Tabet, and P Vecchia 7 Nov 1977 23 p refs In ITALIAN, ENGLISH summary Presented at the Meeting on Energy in the Future, Rome, 9-10 Jul 1977
 (ISS-L-77/11) Avail NTIS HC A02/MF A01

The different implications of alternative energy sources (nuclear, fusion, and solar) for Italy are discussed from the point of view of environmental problems. Natural limits to the increase of energy production and some energy conservation measures are also considered. Author (ESA)

N78-28669# Istituto Superiore di Sanita, Rome (Italy) Lab di Fisica

CONSIDERATIONS ON SOME ECONOMIC AND ENVIRONMENTAL PROBLEMS RELATED TO ENERGY PRODUCTION, PART 1

7 Dec 1976 47 p In ITALIAN, ENGLISH summary 3 Vol
 (ISS-L-76/15-Pt-1) Avail NTIS HC A03/MF A01

Origins and significance of the environmental energy and economic crises are discussed, with emphasis on the ecological, productive, and economic systems. Ecological and thermodynamic fundamentals are presented. Topics dealt with under the theme - the energy sources: fossil combustibles - include petroleum reserves, carbon and synthetic combustibles, environmental dangers, and inflation resulting from the energy problem. ESA

N78-28670# Istituto Superiore di Sanita, Rome (Italy) Lab di Fisica

CONSIDERATIONS ON SOME ECONOMIC AND ENVIRONMENTAL PROBLEMS RELATED TO ENERGY PRODUCTION, PART 2

14 Dec 1976 35 p In ITALIAN, ENGLISH summary 3 Vol (ISS-L-76/16-Pt-2) Avail NTIS HC A03/MF A01

Topics dealt with under the theme - energy sources nuclear and solar energy - include the development of nuclear power in the U.S., the nuclear hazards, the nuclear economy, and the solar alternative, an antidote against the inflation ESA

N78-28671# Istituto Superiore di Sanita Rome (Italy) Lab di Fisica

CONSIDERATIONS ON SOME ECONOMIC AND ENVIRONMENTAL PROBLEMS RELATED TO ENERGY PRODUCTION, PART 3

21 Dec 1976 43 p In ITALIAN, ENGLISH summary 3 Vol (ISS-L-76/17-Pt-3) Avail NTIS HC A03/MF A01

Environmental and energetic aspects of the transportation system in the U.S. are considered Topics dealt with under the theme - energy use the petrochemical industry - include substitution of natural products by synthetic products, environmental and energetic consequences nondegradable toxic substances and high energy cost, and the economic origins of petrochemical technology ESA

N78-28672# Joint Publications Research Service, Arlington, Va

TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY PHYSICAL SCIENCES AND TECHNOLOGY, NO 40, METHODS OF GAS PRODUCTION FOR AMMONIA SYNTHESIS

12 Jul 1978 85 p refs Transl into ENGLISH from various Russian documents (JPRS-71447) Avail NTIS HC A05/MF A01

The economic advantages of producing ammonia from the gasification of shale are reviewed The use of natural gas is compared to gasified shale in the ammonia production processes

N78-28673 Joint Publications Research Service, Arlington, Va **A METHOD OF CONVERTING BALTIC SHALE TO PROCESS GAS FOR AMMONIA SYNTHESIS**

Docent Zuhukov *In its* Transl on USSR Sci and Technol Phys Sci and Technol, No 40, Methods of Gas Production for Ammonia Synthesis (JPRS-71447) 12 Jul 1978 p 1-26 refs Transl into ENGLISH from Tr Leningrad Inzhenerno-Ekonomicheskogo Inst (Leningrad), no 36, 1961 p 76-95

Avail NTIS HC A05/MF A01

The main indices and parameters of the processor of shale conversion were determined on a pilot facility As calculated per metric ton of absolutely dry process shale, the yield of intermediate products and finished goods was converted gas - 1150 cu nm, synthesized gas - 1063 cu nm ammonia and carbon dioxide - 355 and 605 kg respectively or urea - 612 kg Synthesized gas was produced by using a steam-air converting mixture, which obviates the need for building and operating an air separation plant The process was characterized by efficiency for utilizing the material potential of the raw material, exceeding the effectiveness of shale utilization for fuel products by conventional methods by a factor of 2.5 J A M

N78-28674 Joint Publications Research Service, Arlington, Va **MODERN SCHEMES OF PROCESS GAS PRODUCTION FOR AMMONIA SYNTHESIS**

Ye Ya Melnikov *In its* Transl on USSR Sci and Technol Phys Sci and Technol, No 40 Methods of Gas Production for Ammonia Synthesis (JPRS-71447) 12 Jul 1978 p 28-51 Transl into ENGLISH from Tr Leningrad Inzhenerno-Ekonomicheskogo Inst (Leningrad), no 37, 1961 p 76-95

Avail NTIS HC A05/MF A01

Specific investments and the cost of synthetic ammonia are presented The raw material resources in the nitrogen industry

in the USSR and noncommunist countries were compared A diagram of the catalytic steam-oxygen conversion of natural gas under pressure is included Gas composition during high temperature conversion of natural gas was also examined

J A M

N78-28675# Joint Publications Research Service Arlington, Va

PROSPECTS FOR THE USE OF CHAMBER GAS

A Ya Arna and P R Lageda *In its* Transl on USSR Sci and Technol Phys Sci and Technol, No 40, Methods of Gas Production for Ammonia Synthesis (JPRS-71447) 12 Jul 1978 p 52-58 refs Transl into ENGLISH from Tr Leningrad Inzhenerno-Ekonomicheskogo Inst (Leningrad), no 37 1961 p 101-106

Avail NTIS HC A05/MF A01

The use of gas from chamber furnaces for ammonia production was found economically more effective than its use as a domestic fuel gas It will be possible to produce ammonia from chamber gas at practically the same cost as ammonia from natural gas Ammonia production from gases is described, using the new system of processing shale with a solid heat transfer media or pyrolysis of shale tar with simultaneous production of unsaturated hydrocarbons The economic effect of the use of chamber gas could be significantly increased by using coke which is currently dumped

J A M

N78-28688# Environmental Protection Agency Ann Arbor, Mich Emission Control Technology Div

AUTOMOBILE EXHAUST EMISSION SURVEILLANCE ANALYSIS OF THE FY 1976 PROGRAM

James A Rutherford Dec 1977 177 p refs (PB-279355/2 EPA-460/3-77-022) Avail NTIS HC A09/MF A01 CSCL 13B

Through the Office of Air and Waste Management, EPA contracts with several independent laboratories to perform dynamometer emission testing of in-use light duty vehicles The Emission Factors Testing Program is a continuing project administered by the Emissions Control Technology Division, a part of the Mobile Source Air Pollution Control (MSAPC) program located in Ann Arbor Michigan The data is summarized from the fifth year (FY 75) in the series and updates the sample to include 1976 model year vehicles as well as provides continued monitoring of previous model years State and local agencies, Federal air pollution officials, automobile manufacturers and concerned citizens can use this summary to estimate the impact of light duty vehicle emissions on air quality and to determine conformity of vehicles to the standards under which they were certified GRA

N78-28695 Utah Univ Salt Lake City **STUDIES IN BASIN AND RANGE VOLCANISM Ph D Thesis**

Stanley Herbert Evans Jr 1978 131 p

Avail Univ Microfilms Order No 78-09960

A suite of silicic volcanic rocks are described associated with the Roosevelt Hot Springs geothermal area in southwestern Utah The volcanic sequence included Tertiary rhyolite 8 m.y. old and obsidian ash and rhyolite of Quaternary age The Quaternary lavas were characterized by high silica content (76.5% SiO₂) and total alkalis in excess of 9 percent Obsidians commonly contained greater amounts of fluorine than water Quaternary alkali-olivine basalt and basanite are also studied which have erupted over 850 sq km in the San Bernardino Valley, Southeastern Arizona The lava field contained flows cones of cinder and agglutinate and several large maars up to 1 km in diameter with associated tuff rings The lavas contained more alumina and alkalis than typical alkali-olivine basalts some varieties contain 6.5% Na₂O and 3.4% K₂O Dissert Abstr

N78-28777# California Univ Berkeley Lawrence Berkeley Lab

POTENTIAL OF ARID ZONE VEGETATION AS A SOURCE OF SUBSTRATES

J A Bassham Nov 1977 44 p refs Presented at Seminar on Microbial Conversion Systems for Food and Fodder Production and Water Management Kuwait City Kuwait 12 Nov 1977 (Contract W-7405-eng-48)

(LBL-7214 Conf-771158-1) Avail NTIS HC A03/MF A01

Vegetation in arid zones as a source of substrates is discussed. Considered are the limitations on efficiency of conversion of solar energy to the stored chemical energy of biomass in green plants, and the subsequent biochemical pathways of carbon dioxide fixation and biosynthesis, as well as the potential of plants endogenous to arid zones. Finally the use of covered agriculture or controlled environmental agriculture is considered both in its present form and in terms of possible extension to the large scale production of stable crops. ERA

N78-28953# California Univ, Livermore Lawrence Livermore Lab

INERTIAL CONFINEMENT FUSION (ICF)

12 Oct '1977 31 p Presented at the 19th Ann Am Phys Soc Meeting, Atlanta, 7-11 Nov 1977

(Contract W-7405-eng-48)

(UCRL-79856, Conf-771136-30) Avail NTIS HC A03/MF A01

Rapid progress was made in the four major areas of ICF-targets, drivers, fusion experiments, and reactors. High gain targets were designed. Laser, electron beam, and heavy ion accelerator drivers appear to be feasible. Record-breaking thermonuclear conditions were experimentally achieved. Detailed diagnostics of laser implosions confirmed predictions of the LASNEX computer program. Experimental facilities are being planned and constructed capable of igniting high gain fusion microexplosions in the mid 1980's. A low cost long lifetime reactor design was developed. ERA

N78-28984# Tetra Tech, Inc., Arlington, Va
US NAVY ENERGY R AND D PROGRESS, 1977

Mar 1978 160 p

(Contract N00014-77-C-0350)

(AD-A053428, TETRAT-A-938-78-361) Avail NTIS HC A08/MF A01 CSCL 05/1

This US Navy Energy R and D Progress report summarizes the progress of the Navy Energy R and D program from October through December 1977 and progress prior to October 1977 which had not previously been documented. Potential energy savings for each project is included. Author (GRA)

N78-28990# Committee on Energy and Natural Resources (U S Senate)

IMPLEMENTATION OF PUBLIC LAW 95-87

Washington GPO 1978 170 p refs. Hearing before Subcomm on Public Lands and Resources of the Comm on Energy and Natural Resources, 95th Congr., 2d Sess., 24 Apr 1978

(GPO-28-863, Publ-95-122) Avail Subcomm on Public Lands and Resources

A hearing to review the implementation of the Federal Surface Control and Reclamation Act is presented. Testimony is heard from heads or their representatives of four Federal agencies regarding the problems they were experiencing in carrying out their responsibilities for implementing the surface mining program. An economic analysis and an environmental impact report are given to assess the program. GY

N78-28993*# Operations Research, Inc., Silver Spring, Md
PHASE 1: DEFINITION OF INTERCITY TRANSPORTATION COMPARISON FRAMEWORK VOLUME 1. SUMMARY Final Report

19 Jul 1978 42 p refs

(Contract NAS2-9815)

(NASA-CR-152152-Vol-1, ORI-TR-1298-Vol-2) Avail NTIS HC A03/MF A01 CSCL 13F

A unified framework for comparing intercity passenger and freight transportation systems is presented. Composite measures for cost, service/demand, energy, and environmental impact were determined. A set of 14 basic measures were articulated to form the foundation for computing the composite measures. A parameter dependency diagram constructed to explicitly interrelate the composite and basic measures is discussed. Ground rules and methodology for developing the values of the basic measures are provided and the use of the framework with existing cost and service data is illustrated for various freight systems. A R H

N78-28994*# Operations Research, Inc., Silver Spring, Md
PHASE 1: DEFINITION OF INTERCITY TRANSPORTATION COMPARISON FRAMEWORK VOLUME 2. METHODOLOGY Final Report

19 Jul 1978 251 p refs

(Contract NAS2-9815)

(NASA-CR-152152-Vol-2, ORI-TR-1298-Vol-2) Avail NTIS HC A12/MF A01 CSCL 13F

Categories of cost and service measures that will appropriately define the characteristics of all intercity transportation systems were established. Previous methods of comparing transportation systems were reviewed. Specific comparison variables, applicable to all modes were defined, and the functional relationships by which these variables are interdependent were explored. A framework by which the set of variables may be employed for comparison of data from the individual systems was constructed. A R H

N78-28997# Philadelphia Electric Co., Pa
EVALUATION OF THE ECONOMICAL AND TECHNOLOGICAL VIABILITY OF VARIOUS UNDERGROUND TRANSMISSION SYSTEMS FOR LONG FEEDS TO URBAN LOAD AREAS Final Report

Dec 1977 365 p refs

(Contract EX-76-C-01-2055)

(HCP/T2055-1) Avail NTIS HC A16/MF A01

The technical and economic suitability of many of the underground power transmission systems that may be available in the 1990's was evaluated. The systems considered included cellulose, polypropylene, and gas insulated cables, oil filled cables, and cryogenic cables for 345 kV to 765 kV ac or dc systems and superconducting cables for 320 kV ac systems and 300 kV dc systems. The results of this economic evaluation and limitation on applying these results to other underground transmission applications are presented. ERA

N78-28999# National Technical Information Service, Springfield, Va

INCINERATION STUDIES, VOLUME 2. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Reports, 1975 - Mar, 1978

Audrey S Hundemann Apr 1978 289 p Supersedes NTIS/PS-77/0331, NTIS/PS-76/0226

(NTIS/PS-78/0367/9, NTIS/PS-77/0331, NTIS/PS-76/0226) Avail NTIS HC \$28.00/MF \$28.00 CSCL 13B

Worldwide research on the incineration of municipal, industrial, agricultural, and shipboard wastes is discussed. Topics cover incinerator design, air pollution control, materials recovery, heat recovery, pyrolysis incineration, and cost studies. (This updated bibliography contains 282 abstracts, 78 of which are new entries to the previous edition.) GRA

N78-29063*# National Aeronautics and Space Administration Langley Research Center Langley Station, Va
PROGRESS ON COAL-DERIVED FUELS FOR AVIATION SYSTEMS

Robert D Witcofski In: ITS CTOL Transport Technol., 1978 1978

p 927-950 refs

Avail NTIS HC A18/MF A01 CSCL 21D

The results of engineering studies of coal-derived aviation fuels and their potential application to the air transportation system are presented. Synthetic aviation kerosene (SYN JET-A), liquid methane (LCH4) and liquid hydrogen (LH2) appear to be the most promising coal-derived fuels. Aircraft configurations fueled with LH2, their fuel systems, and their ground requirements at the airport are identified. Energy efficiency, transportation hazards, and costs are among the factors considered. It is indicated that LCH4 is the most energy efficient to produce, and provides the most efficient utilization of coal resources and the least expensive ticket as well. J M S

N78-29103* General Electric Co., Cincinnati, Ohio Aircraft Engine Group

LONG-TERM CF6 ENGINE PERFORMANCE DETERIORATION: EVALUATION OF ENGINE S/N 451-380

Final Report

W H Kramer and J J Smith Aug 1978 112 p

(Contract NAS3-20631)

(NASA-CR-159390) Avail NTIS HC A06/MF A01 CSCL 21E

The performance testing and analytical teardown of CF6-6D engine serial number 451-380 which was recently removed from a DC-10 aircraft is summarized. The investigative test program was conducted inbound prior to normal overhaul/refurbishment. The performance testing included an inbound test, a test following cleaning of the low pressure turbine airfoils, and a final test after leading edge rework and cleaning the stage one fan blades. The analytical teardown consisted of detailed disassembly inspection measurements and airfoil surface finish checks of the as-received deteriorated hardware. Aspects discussed include the analysis of the test cell performance data, a complete analytical teardown report with a detailed description of all observed hardware distress and an analytical assessment of the performance loss (deterioration) relating measured hardware conditions to losses in both specific fuel consumption and exhaust gas temperature. A R H

N78-29133* Boeing Aerospace Co., Seattle, Wash. Space Div

SOLAR POWER SATELLITE SYSTEM DEFINITION STUDY PART 3. PREFERRED CONCEPT SYSTEM DEFINITION

May 1978 364 p

(Contract NAS9-15196)

(NASA-CR-151746 D180-24071-1-Pt-3) Avail NTIS HC A16/MF A01 CSCL 22B

A concise but complete system description for the preferred concept of the Solar Power Satellite System is presented. Significant selection decisions included the following: (1) single crystal silicon solar cells, (2) glass encapsulated solar cell blankets, (3) concentration ratio 1, (4) graphite composite materials for primary structure, (5) electric propulsion for attitude control, (6) klystron RF amplifier tubes for the transmitter, (7) one kilometer diameter transmitter with a design transmission link output power of 5,000 megawatts, (8) construction in low earth orbit with self-powered transfer of satellite modules to geosynchronous orbit, and (9) two-stage winged fully reusable rocket vehicle for transportation to low earth orbit. A R H

N78-29175 Carnegie-Mellon Univ., Pittsburgh, Pa.
A MECHANISM FOR ULTRALOW INTERFACIAL TENSION IN SYSTEMS CONTAINING MICROEMULSIONS: THEORETICAL CONSIDERATIONS AND EXPERIMENTS WITH ULTRACENTRIFUGE Ph.D. Thesis

Rei-Nan Hwan 1978 131 p

Avail Univ Microfilms Order No. 78-11503

A theory of ultralow interfacial tensions and their relation to phase separation in micellar solution was developed. The theory predicted that interfaces having very low tensions can be produced when a micellar solution separated into a micelle-rich and a micelle-lean phase. For phase separation to occur under reasonable

conditions, the micelles must contain enough solubilized oil or water to be about 100 Å in diameter or larger. The conditions for phase separation and the composition of the phases in equilibrium were also predicted by the theory. Interfacial tension was calculated by adapting Cahn and Hilliard's approach. Results showed that interfacial tensions can be 0.1 dyne/cm or lower even when the system is far from a consolute point. Predictions of the theory were in general agreement with the data of Healy et al. on low interfacial tensions in oil-water systems with a synthetic petroleum sulfonate surfactant. Dissert. Abstr.

N78-29198# Bureau of Mines, Albany, Oreg. Metallurgy Research Center

METHANATION ACTIVITY OF RANEY NICKEL CATALYSTS: EFFECT OF PROPORTION OF NiAl3 AND Ni2Al3 IN PRECURSOR ALLOYS Technical Report, 6 Jul 1978 - 7 Jul 1977

Laurance L. Oden and James H. Russell 1978 21 p refs

Prepared in cooperation with ERDA

(PB-279656/3, BM-R1-8272) Avail NTIS HC A02/MF A01 CSCL 07D

The Bureau of Mines is developing Raney nickel catalysts for converting synthesis gas derived from coal to synthetic natural gas. The relationship between the composition of Raney nickel alloys in the range NiAl3 to Ni2Al3 equilibrated at 840°C and the properties of catalysts is described. Methanation activity was determined in the temperature range of 300 to 360°C in a flowing gas stream containing 1 pct CO, 8 pct H2 and the remainder He. One ppm H2S was added to the gas stream at 400°C to evaluate the susceptibility of catalysts to sulfur poisoning. GRA

N78-29229# National Technical Information Service, Springfield, Va.

PIPELINE CORROSION. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - May 1978

Mona F. Smith May 1978 140 p

(NTIS/PS-78/0453/7) Avail NTIS HC \$28.00/MF \$28.00 CSCL 11F

Federally-sponsored research on pipeline corrosion in soils, sea water, and fresh water are covered. Studies include pipeline systems containing natural gas, petroleum slurries, water, and volatile or corrosive liquids. Materials for pipelines are discussed as well as inhibitors for pipeline systems. Coatings, linings, welding, and testing are described as they relate to corrosion. (134 abstracts) GRA

N78-29230# National Technical Information Service, Springfield, Va.

PIPELINE CORROSION, VOLUME 1. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1975 - 1976

Mona F. Smith May 1978 180 p

(NTIS/PS-78/0454/5-Vol-1)

Avail NTIS

HC \$28.00/MF \$28.00 CSCL 11F

Citations from worldwide journals are presented on defects and hazards caused by corrosion. Studies on pipelines for natural gas, petroleum, slurries, and water are covered. Pipeline corrosion in sea water and soils is described. Methods of preventing corrosion and testing for defects are included. (173 abstracts) GRA

N78-29231# National Technical Information Service, Springfield, Va.

PIPELINE CORROSION, VOLUME 2. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1977 - May 1978

Mona F. Smith May 1978 144 p

(NTIS/PS-78/0455/2-Vol-2)

Avail NTIS

HC \$28.00/MF \$28.00 CSCL 11F

Worldwide research is cited on corrosion and corrosion prevention of pipelines for natural gas, petroleum, water slurries, and other gases and liquids. Pipes of steel, stainless steel, copper

alloys, galvanized steel, concrete and zinc alloys are the major materials studied. Prevention of corrosion by cathodic protection, coatings, wrappings and linings are covered. The use of plastics for corrosion resistant pipes is included. (137 abstracts) GRA

N78-29259# Loughborough Univ of Technology (England)
Dept of Transport Technology
METHANOL AS A POSSIBLE FUEL FOR AUTOMOTIVE USE

G G Lucas and M F Choi Jul 1977 35 p refs
(TT-7708) Avail NTIS HC A03/MF A01

The state-of-the-art of the use of methanol in internal combustion engines is reviewed. Fuel economy, power output and emission characteristics of methanol-fuel vehicles are reported. Problems associated with automobiles operating with straight methanol are identified. Existing processes for the manufacture of methanol are described and further raw material sources for methanol production and uses are assessed. F O S

N78-29263# Catalytica Associates, Inc. Palo Alto, Calif
EVALUATION OF SULFUR-TOLERANT CATALYTIC PROCESSES FOR PRODUCING PEAK-SHAVING ALCOHOL FUELS Final Report

Feb 1978 70 p refs
(EPRI-AF-687) Avail NTIS HC A04/MF A01

The objective was to determine the economic incentive for developing a sulfur-tolerant methanol synthesis catalyst. Economic evaluations were performed on ten conceptual methanol synthesis processes. Synthesis gas feeds of varying sulfur content were used. A literature and industry survey for the availability of such a sulfur-tolerant catalyst was also performed. Little economic incentive was found for the development of such a catalyst. It was also found that there is now no known sulfur-tolerant catalyst that has sufficient activity for commercial application. ERA

N78-29266# National Technical Information Service, Springfield, Va

SYNTHETIC FUELS FROM MUNICIPAL, INDUSTRIAL, AND AGRICULTURAL WASTES CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Apr 1978

Audrey S Hundemann May 1978 122 p Supersedes NTIS/PS-77/0112, NTIS/PS-76/0795, NTIS/PS-75/655
(NTIS/PS-78/0499/0, NTIS/PS-77/0112, NTIS/PS-76/0795, NTIS/PS-75/655) Avail NTIS HC \$28 00/MF \$28 00 CSCL 21D

Research efforts directed toward production of gaseous and liquid synthetic fuels from solid wastes are discussed. Waste products used in the syntheses include manure, sewage, paper, and wood. In most citations, methane is the primary fuel produced, however the production of oils, ammonia, carbon monoxide, and methyl alcohol is also discussed. This updated bibliography contains 116 abstracts. GRA

N78-29267# National Technical Information Service, Springfield, Va

SYNTHETIC FUELS FROM MUNICIPAL, INDUSTRIAL, AND AGRICULTURAL WASTES CITATIONS FROM THE AMERICAN PETROLEUM WASTE INSTITUTE DATA BASE Progress Report, 1975 - Dec 1977

Audrey S Hundemann May 1978 295 p Supersedes NTIS/PS-77/0113

(NTIS/PS-78/0500/5, NTIS/PS-77/0113) Avail NTIS HC \$28 00/MF \$28 00 CSCL 21D

The Bibliography cites worldwide literature on the production of fuels from waste materials such as animal manure, wood chips, sewage sludge, urban garbage, agricultural wastes, and old automobile tires. This updated bibliography contains 284 abstracts. GRA

N78-29268# National Technical Information Service, Springfield, Va

UNDERGROUND COAL GASIFICATION. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - May 1978

May 1978 200 p Supersedes NTIS/PS-77/0477, NTIS/PS-76/0407

(NTIS/PS-78/0485/9, NTIS/PS-77/0477, NTIS/PS-76/0407) Avail NTIS HC \$28 00/MF \$28 00 CSCL 21D

The bibliography of Federally-sponsored research cites all aspects of in-situ gasification techniques, including rock fracturing, combustion, gas removal economics, costs, and environmental factors. This updated bibliography contains 194 abstracts. GRA

N78-29269# National Technical Information Service, Springfield, Va

UNDERGROUND COAL GASIFICATION CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - May 1978

Diane M Cavagnaro May 1978 116 p Supersedes NTIS/PS-77/0478, NTIS/PS-76/0485

(NTIS/PS-78/0486/7, NTIS/PS-77/0478, NTIS/PS-76/0485) Avail NTIS CSCL 21D

The bibliography presents worldwide research pertaining to underground (in-situ) coal gasification. It includes environmental effects, the different processes and techniques that are used, gas removal, rock fracturing, costs, and economics. This updated bibliography contains 109 abstracts. GRA

N78-29270# National Technical Information Service, Springfield, Va

DESULFURIZATION OF COAL AND PETROLEUM, VOLUME 2 A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1976 - May 1978

Diane M Cavagnaro May 1978 226 p Supersedes NTIS/PS-77/0434, NTIS/PS-76/0399, NTIS/PS-75/381, COM-74-10935

(NTIS/PS-78/0497/4, NTIS/PS-77/0434, NTIS/PS-76/0399, NTIS/PS-75/381, COM-74-10935) Avail NTIS HC \$28 00/MF \$28 00 CSCL 21D

Aspects of coal and petroleum fuel desulfurization relating to coal preparation, coal liquids, the gasification of coal, and crude oil preparation, where the processes specifically accomplish desulfurization before combustion of the fuel are covered. Coal liquefaction and gasification are only included if sulfur removal is stressed. Flue gas desulfurization and other post-combustion sulfur control processes are excluded. This updated bibliography contains 220 abstracts. GRA

N78-29271# National Technical Information Service, Springfield, Va

COAL TAR TECHNOLOGY A BIBLIOGRAPHY WITH ABSTRACTS Progress Report

Diane M Cavagnaro May 1978 143 p
(NTIS/PS-78/0407/3) Avail NTIS HC \$28 00/MF \$28 00 CSCL 21D

The citations include coal tar production from coal gasification, synthesis of chemicals from coal tar, toxicology, pollution, chemical analysis, and the use of coal tar as a wood preservative. GRA

N78-29273# Kentucky Univ., Lexington Dept of Chemical Engineering

SYNTHETIC OIL FROM COAL. THE ECONOMIC IMPACT OF FIVE ALTERNATIVES FOR MAKING HYDROGEN FROM COAL Final Report

H F Moore, E T Kim, and R I Kermode Jan 1978 85 p refs. Sponsored in part by Ashland Oil, Inc., Ky

(Grant NSF AER-73-03259-A03)
(PB-279322/2, IMMR33-PD20-78) Avail NTIS HC A05/MF A01 CSCL 07A

This study evaluated the effect of several hydrogen production configurations on the cost of syncrude produced by a general catalytic liquefaction process. The five cases analyzed were: partial oxidation of coal at 44.7 500, and 1000 psia; partial oxidation of char at 1000 psia; and, partial oxidation of process-derived vacuum bottoms at 1000 psia. Material balances for all cases.

were based on a total coal consumption of 25,000 tons per stream day (TPSD) This study showed that increasing the pressure of partial oxidation 44.7 to 1000 psia reduced the oil cost by 10 percent This incremental savings in going from 500 to 1000 psia was only two percent, which may make this increase marginal GRA

N78-29274# Webb Inst of Naval Architecture, Glen Cove, NY Center for Maritime Studies
POSSIBLE FUTURE MARINE FUELS
 Harry Silla Nov 1977 34 p refs. Sponsored by Dept of Commerce Wash, D C
 (PB-279257/0, NMRC-KP-164) Avail NTIS HC A03/MF A01 CSCL 21D

Several possible future synthetic fuels for marine transportation were compared The production, handling, and utilization of these fuels are discussed Particular emphasis was placed on hydrogen, ammonia, and hydrazine The difficulty of predicting which one of the synthetic fuels will dominate made it necessary to keep abreast of developments with all the fuels GRA

N78-29275# Radian Corp., Austin, Tex
LOW- AND MEDIUM-Btu GASIFICATION SYSTEMS: TECHNOLOGY OVERVIEW Final Task Report, Sep 1977 - Jan. 1978

Paul W Spaite and Gordon C Page Mar 1978 95 p refs Prepared in cooperation with Spaite (Paul W) Co., Cincinnati (Contracts EPA-68-02-2147, EPA-68-02-2149)
 (PB-279641/5, EPA-600/7-78-061) Avail NTIS HC A05/MF A01 CSCL 07A

Systems or combinations of processes are described which are likely to be used for production of low- and medium-Btu gas from coal This involved making judgements as to types of coals that would be processed, types of gasifiers (and auxiliary processes) which would be employed, and markets which would develop for gas from coal Three main sections are discussed (1) status of technology gives a relatively broad definition of future prospects for coal gasification (2) description of technology gives more specific information on processes that are likely to be used commercially, and (3) environmental impacts discusses the kinds of pollutant discharges that must be anticipated GRA

N78-29288# American Society of Mechanical Engineers, New York
ASME REPORT ON PIPELINE SYSTEM SAFETY Final Report

Mar 1978 32 p refs
 (PB-279330/5, ASME/GPT-1978/1) Avail NTIS HC A03/MF A01 CSCL 13L

Work on a project to study the feasibility of the application of system safety to gas piping systems is summarized Based on studies of selected facilities, it was concluded that system safety analysis could be applied to all phases of the design, construction, operation, and maintenance of a natural gas pipeline system GRA

N78-29405 Tulsa Univ Okla
COMPUTER SIMULATION OF NON-DARCY TWO-PHASE FLOW IN OIL RESERVOIRS Ph D Thesis
 Sif-el Kamel Kadi 1977 101 p
 Avail Univ Microfilms Order No 78-05699

A study of computer simulation was extended to single-phase oil and to two-phase (oil and gas) non-Darcy flow with emphasis on the inflow performance relationship (IPR) The research considers the following (1) the pressure behavior of black oil non-Darcy flow (2) two-phase non-Darcy flow behavior in a solution-gas drive reservoir pressure and saturation were investigated, (3) flow-afterflow tests above and below the saturation pressure in a solution-gas drive reservoir with formation damage or improvement around the wellbore Analysis of the numerical results reveals that the oil non-Darcy pressure

drawdown behaves like water non-Darcy pressure drawdown as investigated by fluid dynamists moreover it also behaves like pressure drawdown in gas wells with turbulent flow The formation flow capacity indicates the non-Darcy flow induces a skin which is rate dependent Dissert Abstr

N78-29420# National Aerospace Lab, Amsterdam (Netherlands) Spaceflight Div
THEORY AND DESIGN OF CONVENTIONAL HEAT PIPES FOR SPACE APPLICATIONS

A A M Delil 1 May 1977 170 p refs
 (NLR-TR-77001-U) Avail NTIS HC A08/MF A01

Possible operation principles and applications of heat pipes are scanned The governing equations for a model of a conventional heat pipe (including the limits to the heat transfer capability) are derived The theoretical derivation of the formulae for the various thermal resistances associated with heat transfer in and by heat pipes and the equations necessary for the calculation of the resulting temperature distributions is described Design philosophy is presented and design procedures are illustrated Data required for a proper heat pipe design are compiled Typical space applications of heat pipes (both existing systems and possible future applications) are surveyed Specific topics and problem areas associated with heat pipe use in space are indicated Author (ESA)

N78-29449*# Mechanical Technology, Inc., Latham, N Y
HYDRODYNAMIC AIR LUBRICATED COMPLIANT SURFACE BEARING FOR AN AUTOMOTIVE GAS TURBINE ENGINE 2: MATERIALS AND COATINGS Final Report
 Bharat Bhushan, David Ruscitto, and Stanley Gray Jul 1978 139 p refs
 (Contracts NAS3-19427, EC-77-A-31-1040)
 (NASA-CR-135402, CONS/9427-2) Avail NTIS HC A07/MF A01 CSCL 11A

Material coatings for an air-lubricated, compliant journal bearing for an automotive gas turbine engine were exposed to service test temperatures of 540 C or 650 C for 300 hours, and to 10 temperature cycles from room temperatures to the service test temperatures Selected coatings were then put on journal and partial-arc foils and tested in start-stop cycle tests at 14 kPa (2 psi) loading for 2000 cycles Half of the test cycles were performed at a test chamber service temperature of 540 C (1000 F) or 650 C (1200 F), the other half were performed at room temperature Based on test results, the following combinations and their service temperature limitations are recommended HL-800 TM (CdO and graphite) on foil versus chrome carbide on journal up to 370 C (700 F), NASA PS 120 (Tribaloy 400, silver and CaF₂ on journal versus uncoated foil up to 540 C (1000 F), and Kaman DES on journal and foil up to 640 C (1200 F) Kaman DES coating system was further tested successfully at 35 kPa (5 psi) loading for 2000 start-stop cycles A R H

N78-29465# Charles River Associates, Inc., Cambridge, Mass
INDUCING THE DEVELOPMENT AND ADOPTION OF SOCIALLY EFFICIENT AUTOMOTIVE TECHNOLOGY Final Report, Jan - Jun 1977
 Hayden Boyd Feb 1978 63 p refs Sponsored by DOT
 (PB-279454/3, CRA-322, DOT-TSC-RSPD-78-4) Avail NTIS HC A04/MF A01 CSCL 13F

Federal policies for inducing the development and adoption of innovative automobile technology are examined using a welfare economics framework Socially efficient technology was defined and criteria were identified for evaluating public policies, these include (1) feasibility and efficacy, (2) mechanism for tradeoffs, (3) information requirements, (4) incentives for information generation (5) incentives for optimizing technology, and (6) effects on uncertainty Current and alternative policies were evaluated by the criteria Policies which place greater reliance on market forces, product information and fiscal incentives can overcome many of the barriers to innovation which confront performance standards GRA

N78-29547# Los Alamos Scientific Lab., N. Mex
GEOTHERMAL RESERVOIR CATEGORIZATION AND STIMULATION STUDY

Harold L. Overton (CER Inc.) and Robert J. Hanold Jul 1977
 62 p refs
 (Contract W-7405-eng-36)
 (LA-6889-MS) Avail NTIS HC A04/MF A01

Analyses of the fraction of geothermal wells that are dry indicate that geothermal reservoirs can be fitted into four basic categories: (1) Quaternary to late Tertiary sediments, (2) Quaternary to late Tertiary extrusives, (3) Mesozoic or older metamorphic rocks, and (4) Precambrian or younger rocks. Failure of geothermal wells to flow economically is due mainly to low permeability formations in unfractured regions. It is the high stress/low permeability category that is most amenable to artificial stimulation by hydraulic fracturing, propellant fracturing, or chemical explosive fracturing. Category (1) geothermal fields are not recommended for artificial stimulation because these younger sediments almost always produce warm or hot water. Most geothermal fields fit into category (2) and in certain cases, possess some potential for stimulation. The Geysers is a category (3) field, and its highly stressed brittle rocks should make this site amenable to stimulation by explosive fracturing techniques. Roosevelt Springs, UT, well 9-1 is in category (4) and is a flow failure. It represents a prime candidate for stimulation by hydraulic fracturing. ERA

N78-29551# National Technical Information Service, Springfield, Va

OIL SHALE MINING, PROCESSING, USES, AND ENVIRONMENTAL IMPACTS, VOLUME 2 CITATIONS FROM THE NTIS DATA BASE Progress Report, 1976 - Apr 1978

Audrey S. Hundemann May 1978 273 p Supersedes NTIS/PS-77/0385, NTIS/PS-76/0319, NTIS/PS-75/362, COM-74-10969
 (NTIS/PS-78/0423/0, NTIS/PS-77/0385, NTIS/PS-76/0319, NTIS/PS-75/362, COM-74-10969) Avail NTIS HC \$28.00/MF \$28.00 CSCL 081

This bibliography contains 118 abstracts. Government-funded research on exploration, mining, retorting, chemistry, environmental impacts, and policies relating to oil shale research is covered. Abstracts discuss such things as oil shale air and water pollution control, production of synthetic fuels, use of spent oil shale in road construction, identification of research and development priorities, and in situ recovery of shale oil. GRA

N78-29552# National Technical Information Service, Springfield, Va

OIL SHALE MINING, PROCESSING, USES, AND ENVIRONMENTAL IMPACTS, VOLUME 2 CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1976 - Apr 1978

Audrey S. Hundemann May 1978 281 p Supersedes NTIS/PS-77/0387, NTIS/PS-76/0320, (NTIS/PS-78/0424/8, NTIS/PS-77/0387, NTIS/PS-76/0320) Avail NTIS HC \$28.00/MF \$28.00 CSCL 081

This bibliography contains 272 abstracts. Worldwide research on exploration, mining, retorting, chemistry, thermal studies, environmental impacts, and policies relating to oil shale research is discussed. The production of synthetic fuels from shale oil and the economics of oil shale operations are included. GRA

N78-29553# Kentucky Univ., Lexington
ESTIMATING ENVIRONMENTAL DAMAGES FROM SURFACE MINING OF COAL IN APPALACHIA: A CASE STUDY Final Report

Alan Randall, Orlen Grunewald, Angelos Pagoulatos, Richard Aussen, and Sue Johnson Jan 1978 143 p refs
 (Contract EPA-68-01-3586)
 (PB-279150/7, EPA-600/2-78-003) Avail NTIS HC A07/MF A01 CSCL 081

The value of environmental damage from surface mining for coal was estimated under four alternative regulatory regimes: (1) the existing regulations, (2) a 'no regulations' regime, (3) a regulatory regime similar to that which would be established by

a Federal surface mining and reclamation bill, and (4) an alternative regulatory framework generated by the research team, which relies more heavily on economic incentives for damage prevention and reclamation. Aesthetic damage, deterioration of water quality for domestic, commercial, and industrial uses, damages from increased floodings, damage to land and buildings, and damage to fish, wildlife, and recreation-related activities are determined. GRA

N78-29559# Kentucky Univ., Lexington, Inst. for Mining and Minerals Research

PROCEEDINGS 3RD KENTUCKY COAL REFUSE DISPOSAL AND UTILIZATION SEMINAR

Jerry G. Rose Dec 1977 119 p Conf. held at Lexington, Kentucky, 11-12 May 1977. Sponsored in part by Southeast Community Coll., Cumberland, Kentucky.
 (PB-279321/4, IMMR32-M4-77) Avail NTIS HC A06/MF A01 CSCL 081

State-of-the-art of coal cleaning and preparation is reviewed. Preparation plant design and construction, refuse treatment and disposal, and waste utilization are among the topics discussed. Economic aspects are included. GRA

N78-29563# Iowa Univ., Iowa City, Inst. of Hydraulic Research

THERMAL REGIMES OF THE MISSISSIPPI AND MISSOURI RIVERS DOWNSTREAM FROM THE SOUTHERN IOWA BORDER

A. R. Giaquinta and Titus T. C. Keng Jan 1978 202 p refs
 Sponsored in part by Office of Water Res. and Technol.
 (PB-279470/9, IHR-211) Avail NTIS HC A10/MF A01 CSCL 08H

The steady state version of the Iowa Thermal Regime Model (ITRM), a numerical model for the calculation of streamwise temperature distributions in rivers, was used to determine the existing and future thermal regimes of the Mississippi and Missouri Rivers downstream from the southern Iowa border. The basic equations governing the conservation of thermal energy in a free surface flow were reviewed, and the numerical model is presented. The empirical equations used to compute various heat transfer quantities are listed. The natural thermal regimes and the modified thermal regimes resulting from the imposition of external heat loads from power plants and other sources were calculated, and results are shown in the form of temperature distributions along the rivers for each case studied. GRA

N78-29564 State Univ. of New York at Buffalo
HYDRODESULFURIZATION AND LIQUEFACTION OF A BITUMINOUS COAL IN A BATCH AUTOCLAVE WITH PARTICULATE AND MONOLITH CATALYSTS Ph.D. Thesis

James Scinta 1978 190 p
 Avail Univ. Microfilms Order No. 78-10662

The experiments were divided into two studies: (1) a 2 to the 3d power factorial design to investigate the principle effects and interactions of catalyst pore diameter (100 Å and 200 Å), catalyst presulfiding (presulfided or not presulfided), and autoclave stirring rate (250 rpm and 500 rpm), and (2) a series of duplicate experiments to study the effects of three novel cobalt-molybdate monolith catalysts. Dissert. Abstr.

N78-29566*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
PERFORMANCE AND STABILITY ANALYSIS OF A PHOTOVOLTAIC POWER SYSTEM Final Report

Walter C. Merrill, Ronald J. Blaha, and Roy L. Pickrell Aug 1978 43 p refs
 (Contract E(49-26)-1022)
 (NASA-TM-78880, E-9609, DOE/NASA/1022-78/30) Avail NTIS HC A03/MF A01 CSCL 10A

The performance and stability characteristics of a 10 kVA

photovoltaic power system are studied using linear Bode analysis and a nonlinear analog simulation. Power conversion efficiencies, system stability and system transient performance results are given for system operation at various levels of solar insolation. Additionally system operation and the modeling of system components for the purpose of computer simulation are described. F O S

N78-29567*# General Electric Co. Wilmington, Mass. Aircraft Equipment Div
SOLID POLYMER ELECTROLYTE (SPE) FUEL CELL TECHNOLOGY PROGRAM Final Report
 15 Mar 1978 88 p
 (Contract NAS9-15286)
 (NASA-CR-151750 TPR-047) Avail NTIS HC A05/MF A01 CSDL 22A

Many previously demonstrated improved fuel cell features were consolidated to (1) obtain a better understanding of the observed characteristics of the operating laboratory-sized cells, (2) evaluate appropriate improved fuel cell features in 0.7 sq ft cell hardware, and (3) study the resultant fuel cell capability and determine its impact on various potential fuel cell space missions. The observed performance characteristics of the fuel cell at high temperatures and high current densities were matched with a theoretical model based on the change in Gibbs free energy voltage with respect to temperature and internal resistance change with current density. Excellent agreement between the observed and model performance was obtained. The observed performance decay with operational time on cells with very low noble metal loadings (0.05 mg/sq cm) were shown to be related to loss in surface area. Cells with the baseline amount of noble catalyst electrode loading demonstrated over 40,000 hours of stable performance. A R H

N78-29570*# CALMAC Mfg Co. Englewood, N J
DESIGN AND INSTALLATION PACKAGE FOR A SOLAR POWERED PUMP
 Jul 1978 34 p refs. Prepared for DOE
 (Contract NAS8-32253)
 (NASA-CR-150740) Avail NTIS HC A03/MF A01 CSDL 10A

The design and installation procedures of a solar powered pump developed by Calmac Manufacturing Company are presented. Subsystem installation operation and maintenance requirements, subsystem performance specifications and detailed design drawings are included. J M S

N78-29571*# Solar Control Corp., Boulder, Colo
INSTALLATION PACKAGE FOR 77-180 SOLARSTAT AND 77-1 CONTROLLER
 Jul 1978 25 p. Prepared for DOE
 (Contract NAS8-32258)
 (NASA-CR-150743) Avail NTIS HC A02/MF A01 CSDL 10A

The installation operation, and maintenance of the SOLARSTAT and the basic modular controller are described. Specifications are included. J M S

N78-29572*# National Aeronautics and Space Administration Marshall Space Flight Center, Huntsville, Ala
MSFC ASSESSMENT OF OWENS-ILLINOIS SUNPAK COLLECTOR PROBLEMS Final Report
 Bernhard L. Wiesenmaier Jul 1978 62 p refs. Prepared for DOE
 (NASA-TM-78179) Avail NTIS HC A04/MF A01 CSDL 10A

An in-depth assessment is presented of problems encountered with the Owens-Illinois SUNPAK collector installed in several ERDA solar system demonstration sites. Analysis and independent tests of the collector in the MSFC Solar Simulator where the system failure conditions were duplicated are included. The basic design of the SUNPAK collector was shown to be sound, however, material limitations dictate that near-term applications constraints be recognized by system designers. MSFC recommendations were presented to ERDA in March 1977. Subsequent retrofit activity by Owens-Illinois appears to have been effective in demonstrating the integrity of the SUNPAK collector. F O S

N78-29573*# National Aeronautics and Space Administration Marshall Space Flight Center Huntsville, Ala
DEVELOPMENT, TESTING, AND CERTIFICATION OF LIFE SCIENCES ENGINEERING SOLAR COLLECTOR Final Report

John M. Caudle Jul 1978 103 p refs. Prepared for DOE
 (NASA-TM-78182) Avail NTIS HC A06/MF A01 CSDL 10A
 Results are presented for the development of an air flat plate collector for use with solar heating combined heating and cooling and hot water systems. The contract was for final development testing and certification of the collector and for delivery of a 320 square foot collector panel. L S

N78-29575*# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio
LARGE WIND TURBINE GENERATORS
 Ronald L. Thomas and Richard M. Donovan Mar 1978 37 p refs. Presented at 5th Energy Technol Conf and Exposition, Washington D C 27 Feb - 1 Mar 1978
 (Contract E(49-26)-1059)
 (NASA-TM-73767 DOE/NASA/1059-78/1, E-9553) Avail NTIS HC A03/MF A01 CSDL 10B

The development associated with large wind turbine systems is briefly described. The scope of this activity includes the development of several large wind turbines ranging in size from 100 kW to several megawatt levels. A description of the wind turbine systems, their programmatic status and a summary of their potential costs is included. L S

N78-29576*# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio
THERMAL ENERGY STORAGE FOR INDUSTRIAL WASTE HEAT RECOVERY
 H. W. Hoffman (ORNL), R. J. Kedl (ORNL) and R. A. Duscha Aug 1978 10 p. Presented at 13th Intersociety Energy Conversion Engineering Conf., San Diego, Calif. 20-25 Aug 1978
 (Contracts EC-77-A-31-1034 W-7405-eng-26)
 (NASA-TM-78953 DOE/NASA/1034-78/2, E-9702) Avail NTIS HC A02/MF A01 CSDL 10C

The potential is examined for waste heat recovery and reuse through thermal energy storage in five specific industrial categories: (1) primary aluminum, (2) cement, (3) food processing, (4) paper and pulp, and (5) iron and steel. Preliminary results from Phase 1 feasibility studies suggest energy savings through fossil fuel displacement approaching 0.1 quad/yr in the 1985 period. Early implementation of recovery technologies with minimal development appears likely in the food processing and paper and pulp industries. Development of the other three categories though equally desirable will probably require a greater investment in time and dollars. L S

N78-29577*# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio
STORAGE SYSTEMS FOR SOLAR THERMAL POWER
 James E. Calogeras and Larry H. Gordon Aug 1978 9 p refs. Presented at the 13th Intersoc. Energy Conversion Eng Conf., San Diego, Calif. 20-25 Aug 1978
 (Contract EC-77-A-31-1034)
 (NASA-TM-78952 DOE/NASA/1034-78/1 E-9698) Avail NTIS HC A02/MF A01 CSDL 10C

The development status is reviewed of some thermal energy storage technologies specifically oriented towards providing diurnal heat storage for solar central power systems and solar total energy systems. These technologies include sensible heat storage in caverns and latent heat storage using both active and passive heat exchange processes. In addition, selected thermal storage concepts which appear promising to a variety of advanced solar thermal system applications are discussed. L S

N78-29578*# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio
UTILIZATION OF SOLAR ENERGY IN DEVELOPING COUNTRIES IDENTIFYING SOME POTENTIAL MARKETS

Gerald F Hein and Toufiq A Siddiqi (Environment and Policy Inst Honolulu, Hawaii) Feb 1978 13 p refs Presented at the Ann Meeting of the Am Assoc for the Advan of Sci, Washington, D C, 12-17 Feb 1978 (Contract E(49-28)-1022)

(NASA-TM-78964, DOE/NASA/1022-78/41) Avail NTIS HC A02/MF A01 CSCL 10B

The potential use of solar electricity generated from photovoltaic cells is examined for nineteen developing nations Energy and economic profiles are summarized for each country A comparison is made between the use of autogeneration and photovoltaics in a rural area of Haiti Author

N78-29579* RHD Sigma, Inc North Hollywood Calif
RS-600 PROGRAMMABLE CONTROLLER SOLAR HEATING AND COOLING Progress Report, 30 Oct 1976 - 1 Jul 1977

Jul 1978 28 p Prepared for DoE

(Contract NAS8-32256)

(NASA-CR-150744) Avail NTIS HC A03/MF A01 CSCL 10A

Three identical microprocessor control subsystems were developed which can be used in heating, heating and cooling, and/or hot water systems for single family, multifamily, or commercial applications The controller incorporates a low cost, highly reliable (all solid state) microprocessor which can be easily reprogrammed J A M

N78-29582# Gesellschaft fuer Vergasung und Verflueissigung von Steinkohle m b H Essen (West Germany)
STUDY OF CAPITAL REQUIREMENTS, COST ESTIMATES AND ECONOMIC ANALYSIS OF A SRC-II (SOLVENT REFINED COAL) PLANT UNDER CONDITIONS RELATED TO THE FEDERAL REPUBLIC OF GERMANY

Karl Guenter Stroppel, Eckard Wolowski, Gerhart VonDiess (Geschaeftsbereich Anlagentechnik, Essen), and Hagen Roehrig (Geschaeftsbereich Anlagentechnik Essen) Dec 1977 106 p In GERMAN, ENGLISH summary (BMFT-FB-T-77-64) Avail NTIS HC A06/MF A01

The capital requirements and costs of a demonstration plant in the US for the production of liquid fuels based on the Solvent Refined Coal (SRC-2) process were estimated and the economics of a commercial SRC-2 plant were analyzed under conditions related to the Federal Republic of Germany The process engineering design was adapted to German conditions and a complete cost calculation based on 1976 prices was elaborated The results demonstrate that an economic operation of the SRC-2 plant cannot be realized at present The specific product cost amounts to approximately 346.-DM/t to 400.-DM/t, depending on the assumptions as regards the project life The current sale price, which equals 272.-DM/t, covers only 68% to 79% of the product cost The capital requirements for a SRC-2 plant with a capacity of 6000 st/d of coal feed were estimated at 800 Mio DM J M S

N78-29583* National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio

THE 200-KILOWATT WIND TURBINE PROJECT

Jan 1978 17 p refs Prepared for DOE

(NASA-TM-79757) Avail NTIS HC A02/MF A01 CSCL 10B

The three 200 kilowatt wind turbines described, compose the first of three separate systems Proposed wind turbines of the two other systems, although similar in design, are larger in both physical size and rated power generation The overall objective of the project is to obtain early operation and performance data while gaining initial experience in the operation of large, horizontal-axis wind turbines in typical utility environments Several of the key issues addressed include the following (1) impact of the variable power output (due to varying wind speeds) on the utility grid (2) compatibility with utility requirements (voltage and frequency control of generated power) (3) demonstration of unattended, fail-safe operation (4) reliability of the wind turbine system (5) required maintenance and (6) initial public reaction and acceptance L S

N78-29584* Rohr Industries, Inc, Chula Vista, Calif
PRELIMINARY POWER TRAIN DESIGN FOR A STATE-OF-THE-ART ELECTRIC VEHICLE Final Report

James A Ross and Gerald A Wooldridge Apr 1978 222 p refs

(Contracts NAS3-20592, EC-77-A-31-1044)

(NASA-CR-135340, RHR-78-035, DOE/NASA/0592-78/1) Avail NTIS HC A10/MF A01 CSCL 10A

The state-of-the-art (SOTA) of electric vehicles built since 1965 was reviewed to establish a base for the preliminary design of a power train for a SOTA electric vehicle The performance of existing electric vehicles were evaluated to establish preliminary specifications for a power train design using state-of-the-art technology and commercially available components Power train components were evaluated and selected using a computer simulation of the SAE J227a Schedule D driving cycle Predicted range was determined for a number of motor and controller combinations in conjunction with the mechanical elements of power trains and a battery pack of sixteen lead-acid batteries 4717 kg at 0.093 MJ/Kg (1040 lbs at 11.7 Whr/lb) On the basis of maximum range and overall system efficiency using the Schedule D cycle, an induction motor and 3 phase inverter/controller was selected as the optimum combination when used with a two-speed transaxle and steel belted radial tires The predicted Schedule D range is 90.4 km (56.2 mi) Four near term improvements to the SOTA were identified: evaluated, and predicted to increase range approximately 7% F O S

N78-29588# Naval Civil Engineering Lab Port Hueneme, Calif
ANALYSIS OF CHAMBERLIN FLAT PLATE SOLAR COLLECTOR USING NATIONAL BUREAU OF STANDARDS TEST CRITERIA

E R Durlak Mar 1978 20 p refs

(ZF57571001)

(AD-A054215, CEL-TN-1517) Avail NTIS MF A02/MF A01 CSCL 10/2

Test results are presented for a flat plate, single glazed solar collector tested in accordance with the National Bureau of Standards test criteria A description of the test apparatus and instrumentation is given A graph of solar collector efficiency is presented There was good agreement between test results and data taken from the manufacturer's brochure Author (GRA)

N78-29589# Xerox Electro-Optical Systems, Pasadena, Calif
THERMAL ENERGY STORAGE DEMONSTRATION UNIT FOR VUILLEUMIER CRYOGENIC COOLER Final Report, 15 Oct. 1976 - 31 Jul. 1977

Robert Richter Oct 1977 138 p refs

(Contract F33615-75-C-2045)

(AD-A054466, AFAPL-TR-77-65, Rept-2340-F) Avail NTIS HC A07/MF A01 CSCL 13/1

A thermal energy storage unit for a High Capacity (Hi-Cap) Vuilleumier Cryogenic Cooler was designed, built and performance tested The unit was specified to have a sufficient thermal energy storage capacity for supplying one hot cylinder of the Hi-Cap Cryogenic cooler for 18 minutes with 650W of power at a maximum power loss of 5 percent through the insulation The discharge of the unit was to take place at a nominal temperature of 1250 F + or - 25 F A thermal energy storage (TES) unit with the hot cylinder of the Vuilleumier cooler was designed with a total thermal capacity of 737100 joules The thermal energy is stored in the form of latent heat of fusion in the eutectic salt composed of lithium fluoride magnesium fluoride and potassium fluoride The unit was insulated with a multiple radiation shield super-insulation consisting of alternate layers of 0.020 inch thick Fiberfrax paper without binder and 0.001 inch Nickel foil The insulation is maintained in a vacuum inside of an insulation container The TES unit is instrumented for temperature control with two chromel alumel thermocouples The single resistance temperature detector (RTD) failed during testing and is inoperative All specified goals for the operation of the TES unit were achieved except for the maximum thermal loss through the insulation which exceeded the goal by 8W This deviation could easily be corrected by interposing a conduction insulation at the thermal ring of the unit The report presents all pertinent design and fabrication information GRA

N78-29592# Center for Energy Policy Inc Boston Mass
**SOLAR ENERGY APPLICATIONS CENTERS A STRATEGY
 TO FACILITATE THE COMMERCIALIZATION OF SOLAR
 ENERGY IN NEW ENGLAND**

Jan 1978 151 p refs

(Contract EG-77-C-01-4007)

(HCP/M4007-01) Avail NTIS HC A08/MF A01

A plan is provided for the Energy Research and Development Administration (ERDA) and in particular the four regional solar energy centers (RSECs) to establish a workable program for increasing the commercial market penetration of available solar technology for space conditioning and water heating. It is recommended that these centers concentrate their commercializing efforts on the building industry. This can be done by establishing a network of small local solar energy applications centers (SEACs) within the four regions to provide on-going assistance and education to members of the industry and their consumers. The present state of the solar energy industry are discussed. The problems faced in the commercialization of solar energy technology, particularly by the building industry are discussed. The programs that these SEACs will need to undertake are described in detail. GY

N78-29593*# National Aeronautics and Space Administration,
 Washington, D C

**SATELLITE POWER SYSTEM (SPS) CONCEPT DEVELOP-
 MENT AND EVALUATION PROGRAM PLAN, JULY 1977 -
 AUGUST 1980**

Feb 1978 63 p refs Prepared in cooperation with DoE

(NASA-TM-79400 DoE/ET-0034)

Avail NTIS

HC A04/MF A01 CSCL 22B

An overview of the program to evaluate the solar satellite power system concept is presented. Environmental health and safety factors are examined along with economic, international and institutional issues. ERA

N78-29596# Monosolar Inc, Santa Monica, Calif
**IMPROVED SEMICONDUCTORS FOR PHOTOVOLTAIC
 SOLAR CELLS Quarterly Report, 1 Apr. - 30 Jun 1977**

30 Jul 1977 8 p refs

(Contract EX-76-C-01-2457)

(DSE/2457-4 QR-4) Avail NTIS HC A02/MF A01

An electroplating method for making thin films of both n- and p-type CdTe and operable photovoltaic junctions of the two together on a substrate of electrically conductive, light transparent SnO₂Sb on glass is described. For the complete junctions measured efficiencies ranging between 0.3 and 0.6% were achieved with indications that higher efficiencies could be achieved upon elimination of a spurious or parasitic junction within the cell whose output appears to buck the desired one. ERA

N78-29596# Catalytic Associates Inc, Palo Alto, Calif
**ASSESSMENT OF FUEL PROCESSING ALTERNATIVES FOR
 FUEL CELL POWER GENERATION Final Report**

J A Cusumano and R B Levy Oct 1977 157 p refs

(EPRI Proj 919-1)

(EPRI-EM-570) Avail NTIS HC A08/MF A01

The hydrogen fuel-cell power plant is expected to become a commercial reality in the near future. The fuel processor which converts hydrocarbon feedstocks to hydrogen is an integral part of this system. Fuel-cell power systems presently being developed are capable of utilizing methane through light naphthas for this purpose; however, a reasonable fuel-cell market will require the use of a number of fuels ranging from synthesis gas to distillate oils. In this context No. 2 fuel oil is of particular interest. The present study focuses on hydrogen production technologies for dispersed fuel-cell power stations, using a No. 2 fuel-oil feedstock. The primary objective is to provide a perspective for the feasibility of efficiently converting this feed to hydrogen in a fuel processor which is integrated with the dispersed power station. The approach involved a comprehensive review and analysis of existing, emerging and conceptual hydrogen production technologies. Of the processes considered, high-temperature steam reforming (both fixed and fluidized catalytic beds) and autothermal reforming are the more promising fuel-processing alternatives. ERA

N78-29597# CER Geonuclear Corp Las Vegas Nev
WESTERN GAS SANDS PROJECT Status Report

1 Sep 1977 100 p

(NVO/0655-100) Avail NTIS HC A05/MF A01

Resource assessment activities consist of those conducted by USGS in Denver and the outcrop study of the eastern Uinta Basin. Some base maps are complete and field investigations in the principal areas of interest are being conducted. Laboratory R and D activities funded by ERDA have been directed toward new tools and instrumentation systems, rock mechanics experiments, mathematical modeling and data analysis. Many items are arbitrarily reported in this category and in the section devoted to the laboratories and Energy Research Centers even though they require considerable field experimentation. The positive results of system development and data analysis techniques in determining fracture orientation have been very encouraging. The Uinta Basin in Utah and Piceance Basin in Colorado have had seven massive hydraulic fracture (MHF) experiments in the Upper Cretaceous tight gas formations. ERA

N78-29598# Illinois Univ Urbana Center for Advanced
 Computation

ERDA NET ENERGY ANALYSIS PROGRAM Final Report

Clark W Bullard 30 Sep 1977 17 p refs

(Contract EY-76-S-02-2865)

(CO-2865-11) Avail NTIS HC A02/MF A01

Work performed from March 1976 through September 1977 in support of the net energy analysis program is summarized. A handbook was prepared for use by persons performing net energy types of goods and services and embodies several methodological advances. Quantitative estimates were made for the effects of certain deviations from this standard, including internalization of R and D expenditures, regulation and capital investment. A method was developed for evaluating net energy impacts of energy conservation options and for comparing them to supply development alternatives. ERA

N78-29599# Microeconomic Associates Berkeley Calif
**OVERVIEW OF THE ECONOMIC THEORY OF UNCER-
 TAINTY AND ITS IMPLICATIONS FOR ENERGY SUPPLY**
 R J Gilbert D M G Newbery and J E Stiglitz Jan 1978
 83 p refs

(EPRI-EA-586) Avail NTIS HC A05/MF A01

An overview is given of economic theory of uncertainty and much of the economics literature of the past 10 to 15 years on risk and uncertainty is summarized. The economic principles of risk bearing, which include such topics as the measurement of risk, the institutional structures by which risks are shared in the economy, activities that reduce risk and market mechanisms that provide incentives for risk reduction. The effects of uncertainty on the price and quantity decisions of firms are examined. Also reviewed are the sources of risk, the characteristics of risk, the producer's attitudes toward risk and the effects of market structure and regulation on decision making. ERA

N78-29603# Sandia Labs Albuquerque, N Mex
**DIAGNOSTICS ASSESSMENT FOR ADVANCED POWER
 SYSTEMS Interim Report**

D R Hardesty, R J Cattolica, W L Flower, M C Branch (Colorado Univ), H W Coleman, L A Rahn, A J Mulac, R A Hill and D P Aeschliman Feb 1978 130 p refs

(Contract EY-76-C-04-0789)

(SAND-78-8206 IR-2) Avail NTIS HC A07/MF A01

Work accomplished during the second six months effort in Sandia Laboratories Diagnostics Assessment Program for the Advanced Power Systems Branch of the Energy Technology Division, Department of Energy is summarized. A principal objective of this program is to perform a continuing review and technical assessment of state-of-the-art diagnostic techniques. The intended application of these techniques is the characterization of the flow at the combustor exit and turbine inlet in advanced open-cycle gas turbine systems which will be used for stationary power generation and which will be fired with coal, coal-derived liquid and gaseous fuels or heavy residual fuels. A brief outline of the principal results and conclusions of the first Interim Report is included. ERA

N78-29605

N78-29605# California Univ Livermore Lawrence Livermore Lab

CURRENT STATUS OF COMPOSITE FLYWHEEL DEVELOPMENT

Richard H Toland 17 Jan 1978 23 p refs Presented at the 23d Natl SAMPE Symp, Anaheim, Calif, 1-4 May 1978 (Contract W-7405-eng-48) (UCRL-80604, Conf-780502-4) Avail NTIS HC A02/MF A01

Recent developments in the applications of fiber composite materials to flywheel energy storage systems are reviewed. The impact of these materials on flywheel energy storage is discussed in relation to transportation systems specifically the performance requirements and the effect of system constraints on the ultimate effectiveness of the composite rotors. General flywheel design concepts are discussed in light of several performance criteria and the inherent design and material limitations including those effecting reliability and life. Specific composite rotors that were built and tested are discussed in terms of their demonstrated performance and are assessed for their potential. Recent government-sponsored research and development programs also are briefly reviewed and recommendations are made for future work. ERA

N78-29608# Sandia Labs, Albuquerque N Mex Aerothermodynamics Div

SLAGGING MHD GENERATOR A PARAMETRIC STUDY

John G Taylor 1977 30 p refs Presented at the 17th Symp on Eng Aspects of MHD Stanford Calif 27 Mar 1978 (Contract EY-76-C-04-0789) (SAND-77-1951) Avail NTIS HC A03/MF A01

The design and performance of a direct coal fired MHD generator depends on the effect the liquid slag layer has on the fluid dynamic heat transfer and electrical characteristics of the generator. A simplified self consistent analysis of the slagging MHD generator is presented. A detailed study of the interaction between the turbulent gasdynamic boundary layer and the condensing slag layer in the presence of electrodynamic forces was initiated. The vapor condensation for a laminar boundary layer flow over infinitely segmented Faraday connected electrodes in the entrance region of the generator was examined. Simply stated a mixture of a condensable vapor (slag) and a noncondensable gas (seeded coal combustion products) flows through an MHD channel with wall temperatures below the condensation temperature of the vapor. The vapor condenses on the walls creating a liquid slag layer. ERA

N78-29609# California Univ Livermore Lawrence Livermore Lab

CONDITIONING OF GEOTHERMAL BRINE EFFLUENTS FOR INJECTION USE OF COAGULANTS

R Quong F Shoepflin (Bechtel Corp) and N D Stout 1 Feb 1978 18 p refs (Contract W-7405-eng-48) (UCID-17716) Avail NTIS HC A02/MF A01

The use of various chemical coagulants and flocculants with spent geothermal brine for enhancing the removal of colloidal solids prior to injection was studied. Brine at 80 to 85 C was obtained from the injection line of the SDG and E/DOE Geothermal Loop Experimental Facility during a period of operation with Magmamax No 1 Fluid. The solids consist primarily of an iron-rich amorphous silica and heavy metal sulfides principal lead. Standard jar testing equipment was used to carry out the tests. ERA

N78-29610# Ohio Agricultural Research and Development Center Wooster

PROCEEDINGS OF A CONFERENCE ON SOLAR ENERGY FOR HEATING GREENHOUSES AND GREENHOUSE-RESIDENTIAL COMBINATIONS

T E Bond, L C Godbey, H F Zornig and Ted H Short, ed Nov 1977 350 p refs Proc held at Cleveland 20-23 Mar 1977 Prepared in cooperation with DoE Washington D C (CONF-770367) Avail NTIS HC A15/MF A01

A research and development effort is reported that evaluates the feasibility of heating and cooling greenhouses and greenhouse-residential combinations by solar energy conversion. Energy

research and energy policy abstracts represent the current state of the art. G G

N78-29611# Brookhaven National Lab Upton N Y ALTERNATE MATERIALS OF CONSTRUCTION FOR GEOTHERMAL APPLICATIONS Progress Report, Jul - Sep 1977

L E Kukacka J Fontana A Zeldin T Sugama W Horn N Carciello and J Amaro 1977 30 p refs (Contract EY-76-C-02-0016) (BNL-50751 PR-14) Avail NTIS HC A03/MF A01

A program to determine if non-metallic materials such as polymers, concrete polymer composites and refractory cements can be utilized as materials of construction in geothermal processes is reported. Several high temperature polymer concrete systems were formulated. Laboratory and field tests were performed in brine flashing brine and steam at temperatures up to 260 C. Laboratory data for exposure times more than two years are available. Results are also available from field exposures of up to 18 months in four geothermal environments. Good durability is indicated. Work at four of these sites is continuing. ERA

N78-29613# Grossman (R E) and Associates, Canoga Park, Calif

REPRESENTATIVE INDUSTRIAL SOLAR ENERGY INSTALLATION, NORTHRIDGE HOSPITAL, NORTHRIDGE, CALIFORNIA

R D Grossman 29 Dec 1977 78 p refs Prepared for Calif Univ, Lawrence Livermore Lab (Contract W-7405-ENG-48) (UCRL-13789) Avail NTIS HC A05/MF A01

An engineering package for the design of a solar water heating system for the Northridge Hospital, a 300 plus bed hospital in Southern California is presented. Flat plate collectors were utilized. Specifications and drawings of the system were given. Calculation sheets were included for the support system structural analysis, heat exchanger performance check, pipe size and pressure load calculations, pump selection analysis, solar collector thermal performance and collector attach system design requirements. Author (ERA)

N78-29614# Dynatrend, Inc, Arlington, Va

NATIONAL FUEL CELL SEMINAR PROGRAM AND ABSTRACTS

1977 124 p refs Seminar held at Boston, 21-23 Jun 1977 Sponsored by DoE (CONF-770664-Absts) Avail NTIS HC A06/MF A01

Abstracts of 40 papers are presented. Topics include fuel cell systems, phosphoric acid fuel cells, molten carbonate fuel cells, solid fuel and solid electrolyte fuel cells, low temperature fuel cells, and fuel utilization. Author (ERA)

N78-29617# National Technical Information Service, Springfield, Va

ENERGY CONSERVATION. BUILDINGS, VOLUME 1 A BIBLIOGRAPHY WITH ABSTRACTS

Audrey S Hundemann May 1978 168 p (NTIS/PS-78/0502/1) Avail NTIS HC \$28.00/MF \$28.00 CSCL 13M

This bibliography contains 162 abstracts. Energy conservation in residential, commercial, and industrial buildings through use of efficient heating, air conditioning, and lighting systems is discussed. Topic areas cover the retrofitting of existing buildings, methods of detecting heat loss, efficient use of electric power, and the use of thermal energy storage and solar heat. Potential for conserving energy in buildings and guidelines and manuals for building owners are included. GRA

N78-29618# National Technical Information Service, Springfield, Va

ENERGY CONSERVATION. BUILDINGS, VOLUME 2 A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1977 - Apr 1978

Audrey S Hundemann May 1978 161 p Supersedes NTIS/PS-77/0396 NTIS/PS-76/0403 NTIS/PS-75/214

COM-74-11138
(NTIS/PS-78/0503/9 NTIS/PS-77/0396) Avail NTIS
HC \$28 00/MF \$28 00 CSCL 13M
This bibliography contains 156 abstracts For abstract see
N78-29617 GRA

N78-29619# Florida Univ Gainesville
**CONCEPTS AND TECHNIQUES FOR EVALUATION OF
ENERGY-RELATED WATER PROBLEMS Final Report**
Flora C Wang Howard T Odum and Melvin E Lehman Dec
1977 70 p refs
(Contract DI-14-34-0001-6236)
(PB-279608/4 W78-05940 OWRT-C-7516(6236)(1)) Avail
NTIS HC A04/MF A01 CSCL 10A

The theory of energy analysis and the classical operational
research techniques (linear programming) are applied towards a
procedure that may serve the resource manager in decision making
The theory investigated involves the concepts of net energy
energy quality and energy amplifier value An attempt is made
to estimate the energy value of water The energy value of
water is equal to the flow that it facilitates in a specific use
GRA

N78-29620# Washington State Univ Pullman
**ENERGY CONSERVATION POLICY EVALUATION. STUDY
MODULE 1A, VOLUME 2 TECHNICAL APPENDIX
Final Report**
Kenneth Bergstresser Robert E Berney, Lewis F Carter, Lloyd
B Craine, and Riley C Dunlap 1978 678 p Sponsored by
Northwest Energy Policy Project Portland Oregon and Pacific
Northwest Regional Commission Vancouver Washington
(PB-279664/7, NEPP-1-A-Vol-2) Avail NTIS
HC A99/MF A01 CSCL 10A

Detailed technical analyses of energy conservation measures
are presented For each measure there is a description of how
the measure works to reduce consumption an assessment of
potential savings costs, and returns to adopters, probable
normal adoption rates under present policies and potential
adoption rates if some additional conservation policy options
are implemented Environmental residuals from energy end uses
and policy preferences of households and energy marketers are
included
GRA

N78-29621# Charles River Associates, Inc Cambridge Mass
INTEGRATING POLICY ANALYSIS Final Report
William R Hughes and J Hayden Boyd 1978 456 p Sponsored
by Northwest Energy Policy Project, Portland, Oregon and Pacific
Northwest Region Commission Vancouver, Washington
(PB-279217/4 NEPP-8) Avail NTIS HC A20/MF A01 CSCL
10A

The future energy supplies and demands in the Pacific
Northwest are discussed along with the principal policy issues
and alternatives which can shape the future of energy in the
region Analyses are provided of the various alternatives and
the environmental impacts are quantified wherever possible
GRA

N78-29623# National Academy of Sciences - National Research
Council, Washington D C
**COAL AS AN ENERGY RESOURCE, CONFLICT AND
CONSENSUS**
Nov 1977 332 p
(PB-279539/1, ISBN-0-309-02728-4) Avail NTIS MF A01,
HC National Academy of Sciences 2101 Constitution Ave
Washington, D C 20418 HC \$11 00 CSCL 10A

Based on proceedings of an Academy Forum this report
brings together both advocates and adversaries for increased
coal production It emphasizes the need to reconcile regional
interests with the energy needs of the nation Some topic areas
covered are The speed and locations at which coal should be
developed environmental impacts of development coal technolo-
gies and development in the Ohio River Valley Kaiparowits
and the Northern Great Plains region
GRA

N78-29626 California Univ, Los Angeles
THE AIR QUALITY AND OIL SPILL IMPLICATIONS OF

ALASKAN OIL IMPORTATION INTO SOUTHERN CALIFOR- NIA Ph D Thesis

Stephen Wayne Kahane 1978 253 p
Avail Univ Microfilms Order No 7811357

The proposed siting of the Standard Oil of Ohio (SOHIO)
marine terminal and storage facilities in Long Beach, California
was discussed The SOHIO the company with the largest share
of Alaskan oil proposes to transship approximately
500,000 barrels/day of Alaskan oil through the Port of Long
Beach The air quality impacts of the proposed SOHIO project
were determined to be of particular concern because of their
potential contribution to further deterioration of ambient air quality
in an already polluted air basin The air pollutant emissions
associated with each of the various activities and operations of
the marine terminal were identified, characterized and discussed
Various operational scenarios were then developed to estimate
emissions during both routine and emergency conditions
Dissert Abstr

N78-29634# California Univ, Livermore Lawrence Livermore
Lab Environmental Sciences Div

STUDIES OF AIR POLLUTION EFFECTS ON VEGETATION

Jan 1978 43 p refs
(Contract W-7405-eng-48)
(UCID-17714) Avail NTIS HC A03/MF A01

The report consists of three parts which summarize pollutant-
vegetation effects research studies These include oxidant effects
of primary productivity in ponderosa pine in the San Bernardino
National Forest air pollution effects on vegetation related to
geothermal power development, and regional assessment of air
pollution impact on vegetation by mathematical modeling ERA

N78-29637# California Univ Livermore **SURVEY OF MODELS TO PREDICT THE EFFECT OF GEOTHERMAL POWER DEVELOPMENT ON DOMESTIC WATER SUPPLIES AND TO DESIGN POLLUTION MONI- TORING METHODS**

K D Pimental 17 Aug 1977 15 p refs Presented at the
Intern Federation for Inform Processing Working Conf on
Modeling and Simulation of Land, Air and Water Resources
Systems, Ghent, 30 Aug 1977 - 2 Sep 1977 Sponsored by
DOE
(UCRL-79977 Conf-770854-1) Avail NTIS
HC A02/MF A01

The computer modeling and simulation of ground water solute
transport, applicable to the design of pollution surveillance
monitoring system is considered Emphasis is placed on the effects
of the development of geothermal power production on water
quality of domestic artesian water wells in an area downstream
from geothermal wells
JMS

N78-29638# Radian Corp Austin Tex **CONTROLLING SO2 EMISSIONS FROM COAL-FIRED STEAM-ELECTRIC GENERATORS, WATER POLLUTION IMPACT VOLUME 1 EXECUTIVE SUMMARY Final Task Report, Apr - Dec, 1977**

R L Sugarek and T G Sipes Mar 1978 34 p
(Contract EPA-68-02-2608)
(PB-279635/7 EPA-600/7-78-045a-Vol-1) Avail NTIS
HC A03/MF A01 CSCL 07A

Results of a comprehensive program to review a New Source
Performance Standards (NSPS) for SO2 emissions from coal-fired
steam-electric generating plants is given The results compare
two alternative standard to the existing NSPS (1 2 lb SO2/million
Btu of heat input) (1) 0.5 lb SO2/million Btu of heat input,
allowing credit (as does the existing NSPS) for physical coal
cleaning or use of low sulfur coal, and (2) 90% removal of SO2
from stack gases, regardless of original coal sulfur content The
comparisons are in terms of their effect on the quality and quantity
of power plant wastewater effluents and on the amount of
plant water consumption
GRA

N78-29639# Radian Corp Austin Tex **CONTROLLING SO2 EMISSIONS FROM COAL-FIRED STEAM-ELECTRIC GENERATORS, WATER POLLUTION IMPACT VOLUME 2 TECHNICAL DISCUSSION Final Task Report, Apr - Dec 1977**

R L Sugarek and T G Sipes Mar 1978 268 p refs
(Contract EPA-68-02-2608)
(PB-279636/5 EPA-600/7-78-045b-Vol-2) Avail NTIS
HC A12/MF A01 CSCL 07A

Potential effects of SO₂ control system effluents on the environment are evaluated and alternative treatment processes are discussed. Volumes and quality of wastewater streams varied very little from one alternative New Source Performance Standard to another, all streams can be treated adequately using commercially available technologies. However, the alternative standards increase total water consumption 8-11%, depending on the FGD process used. Physico-chemical cleaning plus lime/limestone scrubbing increases total water consumed 8-12% GRA

N78-29674*# Maya Development Corp., San Diego, Calif
STUDY OF EFFECTS OF SPACE POWER SATELLITES ON LIFE SUPPORT FUNCTIONS OF THE EARTH'S MAGNETOSPHERE Final Report

Marvin Douglas Robert Laquey, Sherman DeForest, Charles Lindsey and Howard Warshaw 5 May 1977 152 p refs
(Contracts NAS7-100, JPL-954663)
(NASA-CR-156948 Rept-77-1-1) Avail NTIS
HC A08/MF A01 CSCL 04A

The effects of the Satellite Solar Power System (SSPS) on the life support functions of the earth's magnetosphere were investigated. Topics considered include (1) thruster effluent effects on the magnetosphere, (2) biological consequences of SSPS reflected light (3) impact on earth bound astronomy, (4) catastrophic failure and debris, (5) satellite induced processes, and (6) microwave power transmission. Several impacts are identified and recommendations for further studies are provided. JMS

N78-29759# Monosolar Inc., Santa Monica, Calif
IMPROVED SEMICONDUCTORS FOR PHOTOVOLTAIC SOLAR CELLS Quarterly Report, 15 Jul - 31 Oct 1977
30 Nov 1977 18 p refs
(DSE/2457-5, QR-5) Avail NTIS HC A02/MF A01

Electroplating doped cadmium telluride homojunctions on ITO-coated glass substrates using aqueous electrolytes at a temperature of 90 C is described. Latest cells made 90 C display very encouraging values of $V_{sub}/oc = 0.5$ volts showing good junction formation. However J_{sub}/sc is still low around 9 ma/sq cm and fill factor continues to measure 0.25 to 0.3 both indicating a continuing problem either with high series resistance in the layers or at the rear contact made to the p-type layer with silver or both. ERA

N78-29784# National Bureau of Standards Washington D C
Inst for Computer Sciences and Technology
MANAGEMENT OF DATA ELEMENTS IN INFORMATION PROCESSING Final Report

Hazel E McEwen ed Apr 1978 155 p refs. Proceedings of the 3rd Natl Symp held at NBS Gaithersburg Md., 28-30 Sep 1977
(PB-279661/3 NBSIR-78-1446) Avail NTIS
HC A08/MF A01 CSCL 09B

Data element management in the field of health care energy paperwork management trade data standards and museum data is discussed. GRA

N78-29981# Arizona Univ., Tucson Dept of Systems and Industrial Engineering

APPROPRIATE TECHNOLOGY FOR NATURAL RESOURCES DEVELOPMENT AN OVERVIEW, ANNOTATED BIBLIOGRAPHY, AND A GUIDE TO SOURCES OF INFORMATION

Robert L Bulfin and Harry L Weaver 1977 174 p refs
Prepared for the Agency for International Development Washington, D C
(PB-279193/7) Avail NTIS HC A08/MF A01 CSCL 05B

Each application of technology requires a special fit to go with a specific problem: the people, the environment, the economics, the power available and the politics. The philosophy of intermediate technology which advocates the use of the most appropriate (rather than the most modern) technology is examined in relation to developing countries. A bibliography of information sources on appropriate technology lists organizations and publications related to the topic. GRA

N78-29989# Employment and Training Administration Washington, D C Office of Research and Development
A REVIEW OF ENERGY MODELS WITH PARTICULAR REFERENCE TO EMPLOYMENT AND MANPOWER ANALYSIS Final Report

Albert J Eckstein and Dale M Helen Mar 1978 173 p refs
(PB-279447/7) Avail NTIS HC A08/MF A01 CSCL 05C

A review of existing energy models to determine their usefulness with respect to energy-employment issues is presented. Includes an introduction and overview of the energy problem, and identification of the policy issues which predated much of the energy modeling effort. General conclusions from the review of energy models are presented. The report concludes with a discussion of the various employment and manpower issues associated with the energy problem. GRA

N78-29994*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio

A STIRLING ENGINE COMPUTER MODEL FOR PERFORMANCE CALCULATIONS Final Report

Roy Tew, Kent Jefferies, and David Miao Jul 1978 102 p refs
(Contract EC-77-A-31-1011)

(NASA-TM-78884, DOE/NASA/1011-78/24, E-9613) Avail NTIS HC A06/MF A01 CSCL 10B

To support the development of the Stirling engine as a possible alternative to the automobile spark-ignition engine, the thermodynamic characteristics of the Stirling engine were analyzed and modeled on a computer. The modeling techniques used are presented. The performance of an existing rhombic-drive Stirling engine was simulated by use of this computer program, and some typical results are presented. Engine tests are planned in order to evaluate this model. Author

N78-29995*# Econergy Inc., Los Angeles Calif
A STUDY OF CHARACTERISTICS OF INTERCITY TRANSPORTATION SYSTEMS. PHASE 1. DEFINITION OF TRANSPORTATION COMPARISON METHODOLOGY

J Morley English, Jeffrey L Smith, and Melvin W Lifson Aug 1978 202 p refs. Sponsored in part by DOT
(Contract NAS2-9814)
(NASA-CR-152153-1) Avail NTIS HC A10/MF A01 CSCL 13F

Decision making in early transportation planning must be responsive to complex value systems representing various policies and objectives. The assessment of alternative transportation concepts during the early initial phases of the system life cycle, when supportive research and technology development activities are defined, requires estimates of transportation, environmental, and socio-economic impacts throughout the system life cycle, which is a period of some 40 or 50 years. A unified methodological framework for comparing intercity passenger and freight transportation systems is described and is extended to include the comparison of long term transportation trends arising from implementation of the various R & D programs. The attributes of existing and future transportation systems are reviewed in order to establish measures for comparison, define value functions and attribute weightings needed for comparing alternative policy actions for furthering transportation goals. Comparison criteria definitions and an illustrative example are included. ARH

N78-29998# California Univ Berkeley Lawrence Radiation Lab

INDUCTIVE POWER COUPLING FOR AN ELECTRIC HIGHWAY SYSTEM

J G Bolger F A Kirsten, and L S Ng Jan 1978 10 p ref
Presented at the IEEE Vehicular Technol Conf Denver 24 Mar 1978

(Contract W-7405-eng-48)
(LBL-7262 Conf-780303-2) Avail NTIS HC A02/MF A01

A dual mode electric transportation system is described in which energy is electromagnetically transferred from a powered roadway to moving vehicles. Energy from the roadway can be used for high-speed long-range travel and for replenishing energy

stored in the vehicle in batteries or flywheels. The stored energy is then available for short-range travel off the powered highway network. The power coupling between roadway and vehicle is functionally similar to a transformer. A source is embedded in the roadway flush with the surface. When the vehicle's pickup is suspended over the source, energy is magnetically coupled through the clearance air gap between pickup and roadway source. The electromagnetic coupling mechanism was extensively studied through computer models, circuit analyses, and by tests of a full-size physical prototype. The results of these tests are described. ERA

N78-30171# Los Alamos Scientific Lab., N. Mex
STATISTICAL ANALYSIS AND PLANNING OF MULTIHUNDRED-WATT IMPACT TESTS

H. F. Martz, Jr. and M. S. Waterman. Oct 1977. 16 p. refs. (Contract W-7405-eng-36)

(LA-6886-MS) Avail NTIS HC A02/MF A01

Modular multihundred watt (MHW) radioisotope thermoelectric generators (RTG's) were used as a power source for spacecraft. Due to possible environmental contamination by radioactive materials, numerous tests were required to determine and verify the safety of the RTG. There are results available from 27 fueled MHW impact tests regarding hoop failure, fingerprint failure, and fuel failure. Data from the 27 tests were statistically analyzed for relationships that exist between the test design variables and the failure types. Next, these relationships were used to develop a statistical procedure for planning and conducting MHW impact tests or similar tests on other RTG fuel sources. ERA

N78-30176# Sandia Labs., Albuquerque, N. Mex
MATERIALS PROBLEMS IN SOLAR, NUCLEAR, AND STORAGE OF ENERGY

R. S. Claassen. 1978. 29 p. Presented at the 5th Energy Technol. Conf., Washington, D. C., 27 Feb 1978.

(Contract EY-76-C-04-0789)

(SAND-78-0354C) Avail NTIS HC A03/MF A01

Developing energy technologies place increasing demand on material performance and in some cases exceed known material capabilities. Material choices in solar energy systems are dominated by cost. Distributed collectors and the central receiver illustrate practical problems. The demand for absolute safety in nuclear power requires a depth of understanding and level of knowledge about materials unachieved in previous engineering systems. Problems in water-cooled and breeder reactors emphasize the point. Fusion reactors will push far beyond our present knowledge of material response and behavior. Within limits, energy storage is practical today but present technologies such as batteries are being pushed hard and new schemes such as superconducting solenoids and thermochemical storage are under intense study. ERA

N78-30202* National Aeronautics and Space Administration
 Marshall Space Flight Center, Huntsville, Ala
CORROSION INHIBITORS FOR SOLAR HEATING AND COOLING SYSTEMS

T. S. Humphries. Aug 1978. 15 p. refs.

(NASA-TM-78180) Avail NTIS HC A02/MF A01 CSCL 07D

Inhibitors which appeared promising in previous tests and additional inhibitors including several proprietary products were evaluated. Evaluation of the inhibitors was based on corrosion protection afforded an aluminum-mild steel-copper-stainless steel assembly in a hot corrosive water. Of the inhibitors tested two were found to be effective and show promise for protecting multimetallic solar heating systems. S B S

N78-30214# Giner, Inc., Waltham, Mass
STUDY OF CORROSION AND ITS CONTROL IN ALUMINUM SOLAR COLLECTORS Annual Progress Report, 1 Jun. 1976 - 31 May 1977

J. Giner, F. H. Cocks, and D. Wong. 1 Jun 1977. 89 p. refs. (Contract EY-76-C-02-2934)

(COO/2934-4) Avail NTIS HC A05/MF A01

The corrosion resistance of aluminum alloys in water/ethylene glycol mixtures was studied in detail under experimental conditions directly relevant to the operation of existing solar thermal energy collector systems. An aqueous ethylene glycol solution with 35% ethylene glycol by volume was chosen as the typical heat transfer medium throughout the entire program. The scope of this study covers the following range of conditions: (1) four different aluminum alloys (i.e., 99.9%, 1100, 3003 and 3004 series aluminum), (2) 70 to 210 F., (3) stagnant solution, laminar and turbulent flow, (4) under N₂ and air, (5) in the presence of contaminants (e.g., Cl⁻, Cu²⁺ and Fe³⁺ ions), and (6) effects of ethylene glycol decomposition products. The linear polarization resistance technique was used in determining the overall corrosion rate, along with accompanying quantitative metallographic analysis of pit formation and growth. ERA

N78-30215# General Atomic Co., San Diego, Calif
ELECTRODE POLARIZATION STUDIES IN HOT CORROSION SYSTEMS Progress Report, 1 Jun 1977 - 31 May 1978

O. F. Devereux. Feb 1978. 34 p. refs.

(Contract EY-76-S-02-2960)

(COO-2960-2) Avail NTIS HC A03/MF A01

Analysis of thermodynamic models pertaining to coal gasification is near completion. Model 1, comprising a gas phase and a molten salt phase, pertains to laboratory materials tested; model 2 incorporates as well a solid carbon phase and is intended to model typical gasifier environments. Anodic and cathodic polarization measurements on iron, 1018 steel, nickel, and 304 and 316 stainless steel were performed in molten sodium carbonate under air and oxygen. Preliminary metal/gas reactions tests involving iron, and hydrogen sulfide and nitrogen, were performed. Nitrogen reaction is minimal, hydrogen sulfide reaction is very nonuniform, rendering kinetic analysis difficult. ERA

N78-30223# Department of Energy, Oak Ridge, Tenn
FIRST FOUR YEARS OF OPERATION OF THE LNG PLANT AT SKIKDA (ALGERIA): CAUSES AND REMEDIES OF THE CORROSION OF CRYOGENIC EXCHANGES BY MERCURY Bachir Khenat and Tewfik Hasni. [1978]. 16 p. Transl. into ENGLISH from unidentified Algerian report. (DOE-TR-16) Avail NTIS HC A03/MF A01

A report of Skikda LNG plant startup is presented. Discussions are included on the different major technical accidents which occurred in the plant, and the training and installation of operating personnel of the customer. A view is also presented of performances obtained by the plant in general and by certain large equipments in particular including the large axial compressors of the refrigeration cycle, the cryogenic exchangers, and the LNG storage tanks. The first four years of plant operation is summarized emphasizing equipment operation and personnel management. An account of experience with mercury caused corrosion of cryogenic exchangers is included. Author (ERA)

N78-30227# Sandia Labs., Livermore, Calif. Materials Dept
FORMATION OF PROTECTIVE LAYERS ON ALLOYS USED IN COAL GASIFICATION ENVIRONMENTS Quarterly Progress Report, 1 Apr. - 30 Jun. 1977

R. W. Bradshaw, R. E. Stoltz, and D. R. Adolphson. Nov 1977. 36 p.

(Contract EY-76-C-04-0789)

(SAND-77-8277) Avail NTIS HC A03/MF A01

Alloys which resist corrosive coal gasification atmospheres better than existing high temperature alloys such as 310 stainless steel and Ni-Cr binary alloys were investigated. Minor alloying elements were added to existing high temperature alloys which form protective sulfide layers or improved oxide layers in addition to or in place of the usual oxide layer. The protective layers should be spall resistant under the thermal and mechanical cycling conditions encountered in coal gasifiers and be self-healing, in case of failure by cracking or erosion. The level of alloying additions was adjusted to maximize corrosion resistance while at the same time minimize deleterious effects on mechanical properties and fabricability. ERA

N78-30259# Southwest Research Inst, San Antonio, Tex Army Fuels and Lubricants Research Lab
EFFECTS OF HIGH AVAILABILITY FUELS ON COMBUSTOR PROPERTIES Interim Report
 C A Moses and D W Naegeli Jan 1978 100 p refs
 (Contracts DAAG53-76-C-0003, DAAK70-78-C-0001)
 (AD-A054229, AFLRL-101) Avail NTIS HC A05/MF A01
 CSCL 21/5

Engines now in production or under development were designed for satisfactory performance and life on current specification fuels many of these engines may not be able to handle the stress implied by a broadened fuel specification Among the fuel properties of greatest concern to turbine engine combustion are the aromatic content, the distillation curve, and the viscosity Fuel bound nitrogen is one new property which has emerged from the use of syncrude fuels because of additional NOx found in the exhaust GRA

N78-30261# Sandia Labs, Albuquerque, N Mex
STUDY OF THE PRODUCTION OF SHALE OIL FROM OIL SHALE IN WUERTEMBERG Final Report
 Frank H Reed May 1977 93 p Transl into ENGLISH of German report FIAT-447, 31 Oct 1945 Sponsored by DOE (SAND-77-6014) Avail NTIS HC A05/MF A01

The geology of the Wurtemberg oil shale deposits is described and development of oil shale processing plants during World War in that area is reviewed It is noted that of ten planned plants four were producing at the time of allied occupation Experimental underground distillation of oil shale near Schorzingen is described Test results showed that it is possible to distill Pasidonia oil shale underground Underground distillation experiments are described in which the effects of distillation chamber cross section were evaluated In experiments conducted to evaluate underground oil shale distillation in very large chambers are detailed ERA

N78-30262# Brookhaven National Lab Upton, N Y
FUSION REACTORS-HIGH TEMPERATURE ELECTROLYSIS (HTE)
 J A Fillo ed Jan 1978 133 p
 (Contract EY-76-C-02-0016)
 (COO/0016-01) Avail NTIS HC A07/MF A01

A reference design for synfuel production based on fusion reactors is discussed High-temperature electrolysis (HTE) has the highest potential efficiency for production of synfuels from fusion, a fusion to hydrogen energy efficiency of about 70% appears possible with 1800 C HTE units and 60% power cycle efficiency, an power cycle efficiency While design efforts are required, HTE units offer the potential to be quickly run in reverse as fuel cells to produce electricity for restart of Tokamaks and/or provide spinning reserve for a grid system The present reference design indicates that a 2000 MW(th) fusion reactor could produce as much as 364 million scf/day of hydrogen which is equivalent in heating value to 20 000 barrels/day gasoline This would fuel about 500,000 autos based on average driving patterns A factor of three reduction in coal feed (tons/day) could be achieved for syngas production if hydrogen from a fusion-HTE system were used to gasify coal, as compared to a conventional syngas plant using coal-derived hydrogen ERA

N78-30263# Department of Energy Oak Ridge Tenn
TESTS AT THE FOS TERMINAL ON THE LNG BEHAVIOR IN LARGE TANKS
 Francois Bellus, Yves Reveillard Christian Bonnaure and Lucien Chevalier [1978] 16 p Transl into ENGLISH from unidentified French report Sponsored by DOE
 (DOE-TR-17) Avail NTIS HC A02/MF A01

The determination of the recovery process of the evaporation gases of the LNG tanks and the setting of rational operating methods imply the exact knowledge of the LNG behavior during its storage The theoretical studies carried out in this direction did not allow removing all the uncertainties so that tests were undertaken on both 35 000 cu m tanks at Fos in order to determine the evaporation rate at constant pressure of a tank for various liquid levels the development of pressure in an entirely insulated tank and the time taken for the return to the thermodynamic equilibrium of LNG when the operating pressure of the tank is suddenly changed Results of simulated operation without recovery of the boiloff gases carried out on several tankers journeys are presented ERA

N78-30264# Parsons (Ralph M) Co Pasadena, Calif
SCREENING EVALUATION SYNTHETIC LIQUID FUELS MANUFACTURE Final Report
 T K Chow and D W Stanbridge Aug 1977 129 p refs
 Sponsored by EPRI
 (EPRI-AF-523) Avail NTIS HC A07/MF A01

Various available and proposed gasification processes in combination with one methanol process in conceptual commercial size plant designs for production of clean liquid fuel from coal were compared A Fischer-Tropsch liquids plant design was included for direct comparison with a methanol case using one gasification process The results of this study indicate that there is an economic advantage to advanced gasification system for production of methanol They also show that there is an economic advantage to production of methanol over that of Fischer-Tropsch liquids when the same type of gasifier is used in both plants Author

N78-30267# National Technical Information Service Springfield Va
HYDROGEN STORAGE PART 2 HYDROGEN AS A HYDRIDE A BIBLIOGRAPHY WITH ABSTRACTS
 Final Report, 1974 - May 1978
 Diane M Cavagnaro Jun 1978 113 p Supersedes NTIS/PS-77/0496 NTIS/PS-76/0461
 (NTIS/PS-78/0547/6 NTIS/PS-77/0496 NTIS/PS-76/0461)
 Avail NTIS HC \$28 00/MF \$28 00 CSCL 21D

This bibliography contains 107 abstracts on hydrogen storage as a hydride Citations discuss the chemical and physical properties of the hydride and how useful it will be for hydrogen storage References also cover the conversion of hydrogen to a hydride and the conversion back to hydrogen GRA

N78-30268# Economics, Statistics and Cooperatives Service, Washington D C
GASOHOL FROM GRAIN THE ECONOMIC ISSUES
 Final Report, 1977 - 1978
 19 Jan 1978 23 p refs Sponsored in part by Committee on the Budget (US House) Task force on physical resources
 (PB-280120/7 ESCS-11 AGERSF-21) Avail NTIS HC A02/MF A01 CSCL 21D

Proposals for using fermentation alcohol from grains as a motor fuel supplement are considered in economic feasibility These proposals originate from the desire of farm groups to develop an added market for of grains and coincide with the Nation's desire to find alternatives to petroleum fuels Results indicate a national program would require the production of 10 billion gallons of ethanol to mix with 90 billion gallons of gasoline to produce 100 billion gallons of gasohol annually GRA

N78-30270# National Technical Information Service Springfield Va

HYDROGEN STORAGE PART 1 STORAGE AS A GAS OR LIQUID A BIBLIOGRAPHY WITH ABSTRACTS Final Report, 1974 - May 1978

Diane M Cavagnaro Jun 1978 118 p Supersedes NTIS/PS-77/0495 NTIS/PS-76/0460
(NTIS/PS-78/0546/8 NTIS/PS-77/0495 NTIS/PS-76/0460)
Avail NTIS HC \$28 00/MF \$28 00 CSCL 21D

This bibliography contains aspects of storing hydrogen as a liquid or a gas Citations cover fuel storage, energy storage and the construction of tanks used to store the material GRA

N78-30293# Department of Energy Washington D C Transportation Energy Conservation Div

HIGHWAY VEHICLE SYSTEMS Summary Report no 13 Mar 1978 451 p refs Presented at the 13th Contractors Coord Meeting Dearborn Mich, 4-6 Oct 1977 (CONF-771037) Avail NTIS HC A20/MF A01

Various types of automobile engines were evaluated for economy in fuel consumption Engine designs and components were specified Alternate types of fuels were also considered

N78-30299# Sandia Labs Albuquerque N Mex

SUMMARY OF VARIABLE DISPLACEMENT ENGINE PROJECT

C W Robinson In DOE Highway Vehicle Systems Mar 1978 p 67-73

Avail NTIS HC A20/MF A01

A variable displacement five cylinder, spark ignition research engine was designed fabricated and tested This design reduced partial load fuel consumption by reducing throttling and friction losses Power was controlled by changing the piston stroke rather than by throttling except at idle and very low power levels A linkage arrangement allowed for continuous changes in stroke and, therefore in engine displacement The prototype has a bore of 3.375 inches and stroke varies from 1 to 4-1/4 inches as displacement varies from 43 to 190 cubic inches The linkage concept was such that clearance volume could be changed in proportion to the stroke Nearly constant compression ratio could be achieved, or (by proper selection of the linkage dimensions) compression ratio could be tailored to optimize the design

J A M

N78-30301# Mechanical Technology Inc Latham N Y DEMONSTRATION OF HYDRAULIC MODULE FOR AN AUTOMOTIVE HYDROMECHANICAL TRANSMISSION

Paul Lewis In DOE Highway Vehicle Systems Mar 1978 p 94-101

Avail NTIS HC A20/MF A01

The engine configuration used a hydrostatic module arranged in a tandem axial relationship with output planetary gearing The modular hydrostatic construction provided direct connection to the engine input and the gearing permitted effective noise isolation and had minimum structural requirements The configuration was attractive in that it used a proven control system conventional automotive design and was compatible in size (envelop), weight and cost with current transmissions The fuel economy gain came from the improved engine efficiency achieved through use of the CVT The CVT has the speed and torque capability to allow the engine to operate close to the minimum SFC while delivering the required road load J A M

N78-30302# AiResearch Mfg Co, Phoenix Ariz

IMPROVING AUTOMOBILE FUEL ECONOMY WITH ACCESSORY DRIVES

C H Lefferts In DOE Highway Vehicle Systems Mar 1978 p 101-124

Avail NTIS HC A20/MF A01

The major program effort produced a variable ratio belt accessory drive and demonstrated performance and fuel economy potential of the constant speed principle The EPA composite

driving cycle fuel economy was improved by 4.8 percent Installation of the drive system permitted cost effective accessory array redesign and improved load matching Vehicle and accessory performance emissions noise and accessory life were also improved J A M

N78-30303# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio

GAS TURBINE PROJECT STATUS

W E Goette In DOE Highway Vehicle Systems Mar 1978 p 125-129

Avail NTIS HC A20/MF A01 CSCL 21A

The state-of-the-art of automobile gas turbine technology, particularly with respect to fuel economy and emissions, was defined An advanced gas turbine system is proposed which incorporates significant advances in technology, and has a fifty to sixty percent gain in fuel economy over the spark ignition engine, while meeting the same goals of the improved gas turbine engine J A M

N78-30304# Chrysler Corp Detroit, Mich

STATUS OF THE CHRYSLER UPGRADED GAS TURBINE ENGINE PROGRAM

C E Wagner In DOE Highway Vehicle Systems Mar 1978 p 129-142

Avail NTIS HC A20/MF A01

The program is currently utilizing five engines Three are being used in test cells for engine development, two at Chrysler and one at NASA and two are installed in vehicles Of the two engines still to be built one will be instrumented for development toward minimizing bulkhead cooling and the other will be for a third car Although no formal endurance effort was undertaken 600 hours of accumulated testing have revealed no significant mechanical problems Of the two running vehicles, one is being used principally for exhibit and the other for control and general vehicle system development Constraints were eased to allow designs which should eliminate the present 25 percent power shortfall J A M

N78-30305# National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio

LEWIS RESEARCH CENTER SUPPORT OF CHRYSLER UPGRADED ENGINE PROGRAM

E L Warren In DOE Highway Vehicle Systems Mar 1978 p 143-149

Avail NTIS HC A20/MF A01 CSCL 21A

Running of the upgraded engine has indicated that although the engine is mechanically sound, it is deficient in power Recent modifications and corrective action have improved this Testing of the engine is being done in the test cell This simulates an automobile installation Located in the inlet flow ducts are two turbine flow meters to measure engine air flow J A M

N78-30306# General Motors Corp, Detroit Mich

IMPROVED HEAVY DUTY GAS TURBINE ENGINE PROGRAM

H E Helms and Franklin A Rockwood In DOE Highway Vehicle Systems Mar 1978 p 149-164

Avail NTIS HC A20/MF A01

Ceramic components were tested on a baseline engine for initial ceramic regenerator disk chemical stability evaluation The baseline engine testing was accomplished at regenerator inlet temperatures of 1425 - 1450 F, 1800 hours of accumulated engine test time has shown chemical stability of aluminum silicate, heavy wall, regenerator disks J A M

N78-30307# Ford Motor Co, Dearborn, Mich

STATUS OF FORD REGENERATOR SYSTEMS DEVELOPMENT

C S Rahnke In DOE Highway Vehicle Systems Mar 1978 p 165-174

Avail NTIS HC A20/MF A01

Data show that two material, AS and MAS, have the potential of achieving the program objective of a B10 life (10,000 hours at 800 C) To date eight AS cores have accumulated over 4000 hours with three accumulating over 5000 hours None of these cores show any serious signs of chemical attack J A M

**N78-30308# Mechanical Technology, Inc., Latham, N Y
DEVELOPMENT OF COMPLIANT FOIL BEARINGS FOR
AUTOMOTIVE GAS TURBINES**

Stanley Gray In DOE Highway Vehicle Systems Mar 1978 p 174-194

Avail NTIS HC A20/MF A01

The 1-1/2 inch diameter bearing was developed and is being used in the engine program at 60,000 rpm and temperatures of 500-600 F, currently limited developmental work is continuing in which the main emphasis is on the long term reliability aspects of the bearing-rotor system and on delivery of engine bearings J A M

**N78-30309# Ford Motor Co Dearborn, Mich
FABRICATION AND TESTING OF SILICON NITRIDE
TURBINE ROTORS**

D L Harstock In DOE Highway Vehicle Systems Mar 1978 p 194-208

Avail NTIS HC A20/MF A01

The most complex and highly stressed component is the duo-density turbine rotor The high strength of hot pressed silicon nitride was used in the hub region where stresses were highest, but temperatures were moderate, and, therefore, creep resulting from the use of a magnesium densification additive was minimized The blade ring was made from reaction bonded silicon nitride, which could be formed into complex airfoil shapes by injection molding or slip casting Although the reaction bonded material was of lower density and, thus, lower strength, it was adequate for the turbine blades, since stress levels in this region were lower than in the hub, and particularly since the creep resistance of the reaction bonded material was superior at high temperature, to that of the hot pressed silicon nitride The hub was formed and bonded to the blade ring in one hot-pressing operation J A M

**N78-30312# Owens-Illinois, Inc Toledo Ohio
IMPROVED HEAT EXCHANGER MATERIALS**

Kenneth Kormanyos In DOE Highway Vehicle Systems Mar 1978 p 225-238

Avail NTIS HC A20/MF A01

Material C-144 was comparable to Corning 9460 AS Both materials have excellent sulfuric acid resistance but only fair sodium chloride resistance All materials have an acceptable thermal expansion of less than 800 ppm Delta L/L change in length from ambient to 1000 C Material C-144 had superior thermal expansion stability to 1100 C and 1200 C exposure compared to Corning 9460 AS J A M

**N78-30314# National Aeronautics and Space Administration
Lewis Research Center Cleveland Ohio
STIRLING ENGINE PROJECT STATUS**

R G Ragsdale In DOE Highway Vehicle Systems Mar 1978 p 241-243

Avail NTIS HC A20/MF A01 CSCL 21A

The status of the Stirling project is summarized Contract negotiations were completed with Ford Motor Company to carry out a major cost-shared development program for an improved engine A parallel but independent development activity by a second team is also planned LS

**N78-30315# Ford Motor Co Dearborn Mich
IMPROVED STIRLING ENGINE DEVELOPMENT**

Norman D Postma In DOE Highway Vehicle Systems Mar 1978 p 243-254

Avail NTIS HC A20/MF A01

Specific data from the 170 HP test program are provided some of the problems encountered are described and the overall plan for continuance of the program under a cost-sharing contract with DOE and NASA is reviewed LS

**N78-30316# National Aeronautics and Space Administration
Lewis Research Center Cleveland, Ohio
INITIAL TEST RESULTS WITH SINGLE CYLINDER RHOMBIC DRIVE STIRLING ENGINE**

James E Carrelli In DOE Highway Vehicle Systems Mar 1978 p 254-258

Avail NTIS HC A20/MF A01 CSCL 131

A brief description is given of the GPU 3-2 hardware, the test methods used, and the result of these tests Comparison is made to unpublished data from similar hydrogen tests performed by the U S Army LS

**N78-30317# Boeing Commercial Airplane Co., Seattle, Wash
EVALUATION OF RECIPROCATING SEALS FOR STIRLING
CYCLE ENGINE APPLICATION**

Al W Waterman In DOE Highway Vehicle Systems Mar 1978 p 258-266

Avail NTIS HC A20/MF A01

The technical effort is divided into the three units of work The first of these is to conduct the analysis of prospective seals and to procure the necessary seals for test During this effort, the designs of three seals were examined for material compatibility with the engine environment adaptability of the geometry to compensate for wear dimensional fit in standard glands, and experience demonstrated in similar environments Two seals were selected as having the best potential for satisfying the rod seal requirements for the Stirling engine One of these seals, the NASA polyimide chevron, requires the development of dimensions to fabricate a 7/8-inch rod size LS

**N78-30318# National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio
MATERIALS TECHNOLOGY ASSESSMENT FOR STIRLING
ENGINES**

Joseph R Stephens In DOE Highway Vehicle Systems Mar 1978 p 267-274

Avail NTIS HC A20/MF A01 CSCL 21A

The objectives are to assess the current state-of-the-art of metals and ceramics that are potential candidate materials for hot components in the improved or advanced Stirling engines, identify materials research development and testing required to support the development of automotive Stirling engines, and recommend materials technology program plans to assure material readiness in time with the engine system development programs LS

**N78-30319# Washington Univ Seattle
SURVEY OF STIRLING ENGINE ANALYTICAL DESIGN
METHODS**

W R Martin In DOE Highway Vehicle Systems Mar 1978 p 274-286

Avail NTIS HC A20/MF A01

The essential character of a Stirling engine is explained and an appreciation of the three orders of Stirling engine design methods is given The first order methods are useful for system studies For already optimized engines this method shows roughly how engine performance relates to operating conditions The second order methods assume that relatively simple formulas can be used to compute the power output and the mechanical and thermal losses This method is short enough to be used for design optimization of the engine The third order methods employ rigorous nodal analysis of the actual engine process with few approximations LS

**N78-30320# Mechanical Technology Inc Latham N Y
THERMAL ENERGY STORAGE/HEAT ENGINE FOR
HIGHWAY VEHICLE PROPULSION**

L R Folsom In DOE Highway Vehicle Systems Mar 1978 p 286-303 refs

Avail NTIS HC A20/MF A01

The feasibility of the thermal energy storage/heat engine concept as an energy conversion system was demonstrated The effectiveness of this system as an alternative to storage battery/electric motor for highway vehicle propulsion was not determined The program involves system studies to assess the

economic and technical feasibility of thermal energy storage (TES) for highway vehicle application. The thermal energy storage concept for highway vehicle propulsion uses a storage unit, a heat transfer device, a heat engine, and a power transmission/differential to drive the wheels. The concept should have inherent compatibility with any heat source that provides the required storage temperature, e.g. 1000K. Electric resistance, solar heating, and the combustion of a fuel are all possible. Once charged, the TES/heat engine propulsion system operates with zero exhaust emissions and with low noise. The Stirling cycle heat engine appears to be the best choice. LS

N78-30321# California Univ., Livermore Lawrence Livermore Lab

ALTERNATIVE FUELS UTILIZATION PROGRAM (AFUP) REASSESSMENT

Carl J. Anderson / In DOE Highway Vehicle Systems Mar 1978 p 305-311
Avail NTIS HC A20/MF A01

Feasibility studies were made on what alternative fuels might be for the 1985-2000 time period. These studies were the corner stone of the program and subsequent activities. Ideas and philosophies were developed along with the projects. A comprehensive review and assessment of the program was instituted. A very brief summary of this effort is presented here. LS

N78-30322# Southwest Research Inst., San Antonio Tex
IDENTIFICATION OF PROBABLE AUTOMOTIVE FUELS COMPOSITION 1985 - 2000

John A. Russel / In DOE Highway Vehicle Systems Mar 1978 p 311-333
Avail NTIS HC A20/MF A01

Methodology is presented to be utilized in projecting most probable compositions of hydrocarbon and methanol automotive fuels, using domestic nonpetroleum resources (oil shale and coal) in their manufacture. Compositional factors are critically contingent upon syncrude conversion process parameters which require further development and definition. If the emerging syncrude-synfuels industry develops at currently foreseeable rates, such syncrudes will be blended with petroleum crudes in such a manner as to have no impact on conventional automotive fuels composition. LS

N78-30323# Solar Turbines International, San Diego, Calif
AUTOMOTIVE HYDROGEN STORAGE WITH MAGNESIUM HYDRIDE

D. A. Rohy / In DOE Highway Vehicle Systems Mar 1978 p 334-341
Avail NTIS HC A20/MF A01

From experimental data it can be seen that modified Mg-Ni alloys offer the greatest potential for reaching that goal. Dissociation temperature at one atmosphere hydrogen pressure is reduced to 204 C for an alloy of Mg, Ni, Cu, Si, and Y from 302 C for Mg_{0.9}Ni_{0.1}Hx. Nickel content has been reduced to 24 percent from 55 percent in Mg₂NiHx. Dissociation temperatures as low as 223 C were achieved with alloys containing 10 percent nickel. Dissociation pressure, hydrogen capacity, kinetics, and safety are other hydride characteristics considered. Practical considerations of the cost, size, weight, fueling, and storage period of a hydride system with energy equivalent of 20 gallons of gasoline are reviewed. Some of the key features of this system are reviewed in this presentation. LS

N78-30324# Miami Univ., Fla
DATA FOR DESIGN OF A HYDROGEN ENGINE - A PROGRESS REPORT

Robert R. Adt, Jr. and Michael R. Swain / In DOE Highway Vehicle Systems Mar 1978 p 341-350

Avail NTIS HC A20/MF A01

A data base is developed for hydrogen engine design and also hydrogen fuel system design. A secondary objective is to try to make sense out of existing hydrogen engine data. Much of the existing data is incoherent. LS

N78-30325# Escher Technology Associates, St. Johns, Mich
ALTERNATIVE FUELS FOR INTERCITY TRUCKING SYSTEMS

William J. D. Escher / In DOE Highway Vehicle Systems Mar 1978 p 350-352
Avail NTIS HC A20/MF A01

The objectives are (1) to compare past and contemporary alternative fuels work with the needs and problems unique to intercity trucking systems; (2) to document the organizational and equipment characteristics of intercity trucking systems and to identify the problems that would be created by the transition to alternative fuels; and (3) to present a Preliminary Program Plan to assist industry and government planners in developing an effective alternative fuels utilization plan for the intercity trucking sector. LS

N78-30326# Department of Energy, Bartlesville, Okla. Energy Research Center

NON-PETROLEUM FUELS AND COMPATIBLE ENGINES 1977 BERC UP-DATE REPORT

R. W. Hurn / In DOE Highway Vehicle Systems Mar 1978 p 352-362 refs
Avail NTIS HC A20/MF A01

Experimental work designed to provide information for best utilization of nonpetroleum transportation fuels is described. Since its inception, this work focused (1) upon fuels and engine systems that could be introduced or adapted in the very short term as a means to alleviate shortfall or potential shortfall in traditional supply and (2) upon fuels that might be produced from oil shale or from coal as supplementary or replacement resources for petroleum. The time frame within which the problem is considered in the context of this program is from the early 80s through the turn of the century. Selection of fuels and fuel components to be used in the study was guided by the following considerations: (1) feasibility of, and energy recovery in producing fuels from the primary energy resource; (2) availability and extent of the primary resource; and (3) suitability of the fuel for those engine and fuel supply systems that could be expected to be (or become) available within the time frame considered. LS

N78-30327# Miami Univ., Fla
ALCOHOL/GASOLINE BLENDS - LEAN MISFIRE LIMITS

Robert R. Adt, Jr. / In DOE Highway Vehicle Systems Mar 1978 p 362-365 refs

Avail NTIS HC A20/MF A01

Various methods were used for measuring lean misfire limit (LML) characteristics. The methods and their relative merits are discussed. The four-cylinder Pontiac engine used in the tests is described and all testing was done at steady state conditions. It is shown that there is an extension of the LML when a 20 percent methanol blend is substituted for Indolene (gasoline). This LML extension is attributed to an extension of ignition failure to leaner mixtures with the blend. Of the commonly-used LML detection methods, the counting of motoring cycles, as ascertained from in-cylinder pressure transducer measurement, is more sensitive than the monitoring of HC emissions. The sensitivity of counting misfires audible at the exhaust pipe falls between the sensitivities of the motoring cycle- and HC monitoring methods. The sensitivity of the standard deviation of the leanest cylinder blowdown-purge pressure as a LML detector is about the same as the sensitivity of the method using motoring cycling frequency-of-occurrence as a LML detector. LS

N78-30328# Santa Clara Univ., Calif
METHANOL UTILIZATION

Richard Pefley / In DOE Highway Vehicle Systems Mar 1978 p 365-376 refs

Avail NTIS HC A20/MF A01

The experimental phase of the program focused on the steady state mapping of performance and exhaust emissions of a dynamometer mounted 2300cc Ford Pinto engine. The Indolene and methanol baseline comparison with original equipment indicated that gains in thermal efficiency and reduced exhaust

emissions (with the exception of aldehydes) are obtained while operating on methanol at the same engine speed, load and equivalence ratio ϕ . All of the observed comparative performance and emissions characteristics were subject to the inherent cylinder-to-cylinder variations in ϕ of this particular 4-cylinder engine. Based on the observed maldistribution for both Indolene and methanol it appears that additional relative gains for methanol ranging from 2 to 5 percent in thermal efficiency (and power) are possible if the maldistribution is eliminated in the range 0.8 less than ϕ less than 1.0. Individual exhaust cylinder measurements were recorded. From these measurements the maldistribution effects on exhaust emissions of the NO_x, UBF and CO were resolved. LS

N78-30329# Southwest Research Inst. San Antonio Tex. Army Fuels and Lubricants Research Labs
ENGINE LUBRICANTS FOR USE IN METHANOL FUELED HIGHWAY VEHICLES
 E. C. Owens /in DOE Highway Vehicle Systems Mar 1978 p 377-385
 Avail NTIS HC A20/MF A01

In order to provide an initial screening for problems when methanol fuels are used in conjunction with present commercially available lubricants a series of engine tests were conducted using the Coordinated Lubricants Research (CLR) single-cylinder engine. The initial test cycle was patterned after the ASTM Sequence II-C cycle normally used to evaluate the rusting and corrosion characteristics of motor oils. After these initial series of wear screening tests were completed it became apparent that methanol produced additional wear apparently of a corrosive nature. The CLR was fitted with a piston which allowed diversion and collection of blowby from the piston ring zone for analysis. Analysis of the liquid and gaseous phases of this blowby showed that methanol produced significant concentrations of formaldehyde. In addition, a significant concentration of formic acid was present. LS

N78-30330# Michigan Univ. Ann Arbor
SOLVING ALCOHOL FUEL PROBLEMS BY ENGINE MODIFICATION
 D. J. Patterson /in DOE Highway Vehicle Systems Mar 1978 p 385-397
 Avail NTIS HC A20/MF A01

The approach used to identify problems and solutions for use of methanol and blends is two pronged. First a careful review of the literature made and pertinent references photocopied and abstracted for the project files. Because published papers often reflect work that is more than one year old and because the understanding of the problems of methanol use is rapidly changing, it was deemed essential to make a number of personal contacts with individuals and laboratories having on-going programs. For this effort, a questionnaire was prepared. This study of the problems and solutions for retrofitting older vehicles is expected to provide guidelines for the design and materials of future vehicles in order to facilitate their operation on methanol or blends should that become desirable. LS

N78-30331# Union Oil Co. of California, Los Angeles
SOLVING ALCOHOL FUEL PROBLEMS BY FUEL MODIFICATION
 James L. Keller /in DOE Highway Vehicle Systems Mar 1978 p 397-407
 Avail NTIS HC A20/MF A01

There are two basically different methods available for altering these properties so as to alleviate problems: (1) converting methanol itself into other chemical species with more favorable properties and (2) modifying fuel composition by adding or removing other components. Examples of the first are conversion to gasoline hydrocarbons by the Mobil process, conversion to t-alkyl methyl ethers by reaction with olefins, and effective conversion to high alcohols. The latter is taken to include the conversion of CO and H₂ partially to higher alcohols instead of to methanol during methanol synthesis. Possibilities for modification by means of additives and otherwise altering fuel composition are discussed. LS

N78-30332# North Atlantic Treaty Organization Brussels (Belgium) Committee on the Challenges of Modern Society
PROCEEDINGS OF THE FOURTH INTERNATIONAL SYMPOSIUM ON AUTOMOTIVE PROPULSION SYSTEMS, VOLUME 1
 Feb 1978 529 p refs. Symp held at Washington D. C. 18-22 Apr 1977. Sponsored by DOE (NATO/CCMS-61-Vol-1 Conf-770430-1-Vol-1). Avail NTIS HC A23/MF A01

The status and plans for research and development in automotive propulsion systems were reviewed. Areas of examination are some of the following: (1) gas turbines, (2) diesel engines, (3) Stirling and Rankine engines, (4) spark ignition improvements, and (5) alternative fuels.

N78-30333*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
CATALYTIC COMBUSTION FOR THE AUTOMOTIVE GAS TURBINE ENGINE
 D. N. Anderson /in NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 1 Feb 1978 p 47-54

Avail NTIS HC A23/MF A01 CSCL 21A

Fuel-air premixing-prevaporizing systems and commercial catalysts were studied as part of a demonstration of a low emissions combustor for an automotive gas turbine engine. A fuel preparation system which would supply a fuel-air mixture which was uniform to within + or - 10 percent of the mean fuel-air ratio with 90 percent fuel vaporization and with no autoignition is described. The catalytic reactor was required to produce emissions which were low enough to meet the most stringent proposed U.S. automotive standards. The overall pressure drop for both systems was to be less than 3 percent, with 1 percent allowed in the fuel-air preparation system and the remainder in the catalytic reactor. BB

N78-30337# United Turbine A.B., Malmo (Sweden)
THREE-SHAFT TURBINE-TRANSMISSION SYSTEMS FOR VEHICULAR APPLICATIONS
 S. O. Kronogard /in NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems Vol 1 Feb 1978 p 94-115 ref.

Avail NTIS HC A23/MF A01

The versatility of the KTT system was highlighted. It was shown how such an engine transmission system can satisfy the installation requirements for light vehicles. Its potential for use in multiple engine installations in larger heavy duty vehicle application was indicated. BB

N78-30339# Booz-Allen Applied Research, Inc., Chicago, Ill.
GAS TURBINE ENGINE APPLICATIONS IN TRANSIT COACHES
 H. Backel /in NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 1 Feb 1978 p 127-136

Avail NTIS HC A23/MF A01

An investigation of gas turbine engine application in transit coaches was conducted to determine the viability of the gas turbine engine as a potential power source for transit coaches. An in-depth survey was taken of gas turbine engine manufacturers whose products may be suitable for installation in transit coaches. Their engine products were evaluated to determine their potential merits against those of the conventional diesel engine used in transit coaches. In addition to research and development engines, nearly 100 DDAD gas turbines were field tested in trucks, transit coaches, intercity coaches, marine craft, industrial electrical generator sets, and air compressors. Three DDAD gas turbine engines were installed in the Transbus prototype coaches. BB

N78-30340# Detroit Diesel Allison, Indianapolis, Ind.
IMPROVED HEAVY DUTY GAS TURBINE ENGINE

H E Helms *In* NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 1 Feb 1978 p 136-164

Avail NTIS HC A23/MF A01

An assessment of sensitivity to change in some of the following was summarized (1) component efficiencies, (2) turbine pressure losses, (3) engine heat rejection, and (4) cooling air requirements. A list of sensitivities compiled shows the change in parameters required to obtain 1 percent improvement in specific fuel consumption. Mechanical analysis was applied to establish which parameters could be improved with development of materials. B B

N78-30346# United Stirling A B, Eskilstuna (Sweden)
THE DEVELOPMENT OF 40-150 kw STIRLING ENGINES IN SWEDEN AND THEIR APPLICATION IN MINING EQUIPMENT, TOTAL ENERGY SYSTEMS AND ROAD VEHICLES

B Hallare *In* NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems Vol 1 Feb 1978 p 248-268 refs

Avail NTIS HC A23/MF A01

Development of the Stirling engine components acceptable to the market is described as well as the development of suitable engine configurations. Special market approach for the engine is also discussed. B B

N78-30348# Ford Motor Co., Dearborn, Mich
STIRLING ENGINE PROGRAM

E Kitzner *In* NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 1 Feb 1978 p 279-291

Avail NTIS HC A23/MF A01

Reduction of emission levels in automobiles is discussed with relation to the Stirling external combustion engine. A detailed review of testing of the 4-215, 170 HP Stirling powered Torino was given. B B

N78-30349# Renner (R A), Livermore Calif
AUTOMOTIVE RANKINE ENGINE DEVELOPMENT

R A Renner *In* NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 1 Feb 1978 p 291-297 ref

Avail NTIS HC A23/MF A01

Recent engine development programs are reviewed in reference to the Rankine automotive engine. Various design approaches were examined. Other areas of consideration were (1) emission control, (2) fuel economy, (3) operating reliability and (4) thermal efficiency. B B

N78-30350# Jay - Carter Enterprises, Inc., Burkburnett, Tex
DESCRIPTION AND TEST RESULTS OF THIRD GENERATION CARTER STEAM SYSTEM AS INSTALLED IN A VW DASHER

J W Carter, Jr *In* NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems Vol 1 Feb 1978 p 297-301 refs

Avail NTIS HC A23/MF A01

Bench tests on the Dasher expander were used in conjunction with a computer simulation to determine the fuel economy of the Dasher vehicle. Projected fuel economy in the 2,500 lb vehicle over the Federal City Driving Cycle is 24.8 mpg which compares to the best achieved by a 2,500 lb 1977 vehicle equipped with an automatic transmission. Its idle fuel rate is between 17 and 2 gallons/hour (75 liters/hour). The complete 85 HP steam system weighs 345 lbs (Figure 203), fits in the Dasher engine compartment, and is capable of vehicle acceleration from 0-60 mph (96.5 km/hour) in 14 seconds. The projected exhaust emissions are below the original 1976 requirements and are a valuable characteristic in the congested city environment. All test results indicate that the engine is a viable candidate as an alternative automobile power plant. B B

N78-30364# Curtiss-Wright Corp, Wood-Ridge, NJ
AN UPDATE OF THE DIRECT INJECTED STRATIFIED CHARGE ROTARY ENGINE DEVELOPMENTS AT CURTISS-WRIGHT

C Jones *In* NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems Vol 1 Feb 1978 p 443-460 refs

Avail NTIS HC A23/MF A01

Development progress of the unthrottled direct injected Stratified Charge Rotary Combustion Engine Program at the Curtiss-Wright Corporation is updated since the 1974 status report. Emphasis during this period was on performance improvements in the automotive road load range. Results are given for a number of variations tested since that date including engine performance with gasoline and other fuels. The baseline configuration was further improved and new designs which have improved fuel consumption and reduced hydrocarbon emissions. These data are presented showing steady state SFC equal or better than representative automotive diesel engines, comparable untreated emission data are presented with HC emissions reduced to a representative band level of automotive carburetted engines with relatively low CO and NOx. G Y

N78-30366# Porsche (Ferdinand) AG, Stuttgart (West Germany)
OPERATING WITH LEAN MIXTURES A SOLUTION FOR THE FUTURE?

R Hahn *In* NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 1 Feb 1978 p 480-487

Avail NTIS HC A23/MF A01

Further development of the passenger car engine will definitely be determined by energy and ecology requirements. The reduction of energy consumption and the optimization of the engine for minimal fuel consumption are of most importance. Engine test data are presented showing the following relationships: (1) shape of the combustion chamber - exhaust emission and fuel consumption, (2) compression ratio - exhaust emission and fuel consumption, and lean mixture limit, (3) exhaust emission and fuel consumption with Porsche vehicles, (4) comparison of combustion processes (5) orifice - auxiliary-chamber-volume, (6) octane requirements of the Porsche 911, (7) exhaust emission of the Porsche 911. G Y

N78-30367# Siemens A G, Erlangen (West Germany) Research Labs

DEVELOPMENT OF A COMPACT GAS GENERATOR FOR FUEL GASIFICATION ABOARD A MOTOR VEHICLE

A Michel *In* NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems Vol 1 Feb 1978 p 488-501

Avail NTIS HC A23/MF A01

The use of gaseous fuels in internal combustion engines represents a suitable means to reduce the specific pollutant emission and the specific fuel consumption when compared with conventional carburetor operations. Gas engines can be operated far into the lean region due to the homogeneous miscibility of fuel gas cylinders. This gives rise to supply problems and makes it difficult to apply this technique to motor vehicles. It is more favorable to generate the low molecular fuel gas from easily storable liquid hydrocarbons within a gas generator aboard the motor vehicle. Requirements for a gas generator are presented. The requirements may be realized through the catalytic partial oxidation of hydrocarbons with air at low air/fuel (A/F) mass ratios. A suitable catalytic process operating with an A/F ratio of 0.7 to 1.7 at about 820 C was developed. G Y

N78-30369# Harker Industries, Inc, Annandale, Va
A NEW LOOK AT EXHAUST GAS RECYCLE AND ITS POTENTIAL FOR IMPROVING FUEL FLEXIBILITY AND ECONOMY OF SPARK IGNITION ENGINES

A Lowi *In* NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems Vol 1 Feb 1978 p 510-515

Avail NTIS HC A23/MF A01

This inquiry proceeds from the general view of engine optimization by charge modification rather than the more narrow objectives of traditional exhaust gas recycle (EGR). Some theoretical and experimental background is reviewed to identify some of the more significant factors characterizing the interaction of the engine and the chemical make-up of the cylinder charge. Some exploratory engine test data were obtained to gain additional appreciation for some of the possibilities for charge modification using certain species found in the engine exhaust. The results were examined for indication of how some of these factors might influence further advancements in the automobile toward reduced rates of both environmental pollution and petroleum consumption. Author

N78-30370# North Atlantic Treaty Organization, Brussels (Belgium)

PROCEEDINGS OF THE FOURTH INTERNATIONAL SYMPOSIUM ON AUTOMOTIVE PROPULSION SYSTEMS, VOLUME 2

Feb 1978 505 p refs Proc held at Washington, D C, 18-22 Apr 1977

(NATO/CCMS-61-Vol-2 Conf-770430/1-Vol-2) Avail NTIS HC A22/MF A01

Automobile engine design and transmission system modifications for fuel economy and emission control are described as well as the efficiency of various alternate fuels. Performance standards for electric automobiles and for electric hybrid systems are discussed.

N78-30371# Postal Service Washington, D C Transportation Div

AUTOMOTIVE EMISSIONS

T A Norman /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 516-524 refs

Avail NTIS HC A22/MF A01

The magnitude of the U.S. Postal fleet and the operational mission of the various sized vehicles used are described. The agency's program for reducing vehicle life cycle costs and decreasing dependence on oil based fuels includes the test and evaluation of light duty diesel engines, stratified charge engines, hydrogen fueled engines, and a gasoline-electric hybrid vehicle. Procedures for testing performance following installation in a 1/4 ton delivery vehicle and during simulated route tests are described. Fuel consumption results indicate that the diesel engine obtained about 122% more miles per gallon during operational use than the gasoline engine under the same conditions. The stratified charge engine when using diesel fuel, exhibits the same level of fuel efficiency as the diesel engine. The hybrid system consumed the greatest amount of fuel. The hydrogen engine is still under development and not yet available for testing. A R H

N78-30372# Johnson Matthey Chemicals Ltd, London (England) **DEVELOPMENT OF CATALYSTS FOR EXHAUST EMISSION CONTROL**

R A Searles /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 524-539 refs

Avail NTIS HC A22/MF A01

The use and effectiveness of noble metal catalysts in exhaust emission control is reviewed. More cost effective methods being considered include using low metal loading catalysts with platinum oxidation, changing the volume of the catalyst while maintaining constant precious metal loading, and improving oxidation catalysts such as platinum/palladium and platinum/rhodium oxidation systems. The effect of low, medium, and high metal loading on CO emissions after 300 hours thermal aging is illustrated. The identification of suitable alloys for fabricating multicellular thin-walled metal supports is discussed. A R H

N78-30373# Daimler-Benz A G Stuttgart (West Germany) **EMISSION CONTROL OF V-ENGINES WITH OXYGEN SENSORS**

H D Schuster /In NATO Proc of the 4th Intern Symp on

Automotive Propulsion Systems, Vol 2 Feb 1978 p 540-552

Avail NTIS HC A22/MF A01

The various possible arrangements for application of closed loop mixture control with oxygen sensor for fuel-injected V-engines with catalytic emission control are described. The decisive criteria such as fuel injection system lay-out of exhaust system, characteristics of control positioning, and operation data of oxygen sensor and catalysts, which define the concept are reviewed. In addition, the conversion rate of three-way catalysts in quasi-stoichiometric operation is discussed. The influence of noble metal composition and quantity, as well as aging of catalysts on the size of the air/fuel ratio-window are explained, also the possibility for optimizing the closed loop system. CVS test results of such systems are presented. Author

N78-30374# Volkswagen A G, Wolfsburg (West Germany) **CRITICAL SURVEY OF TEST PROCEDURES FOR AUTOMOTIVE EMISSIONS**

H Klingenberg /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems Vol 2 Feb 1978 p 553-566

Avail NTIS HC A22/MF A01

Current U.S. and European test procedures for automobile exhaust emissions differ not only in the driving cycles, but also in the sampling and analyzing equipment. The different exhaust emission assembly line test procedures and certification test procedures, including the selective enforcement auditing, are surveyed. A probability analysis carried out shows that there is an important relationship between the certification and assembly line procedures. Proposals for the improvement and standardization of existing procedures are deduced. A R H

N78-30375# Institut Francais du Petrole, Rueil-Malmaison **DIESEL EXHAUST ODOR MEASUREMENTS**

P H Degobert /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 566-581

Avail NTIS HC A22/MF A01

A sensory analysis system was developed to get simultaneous responses of a selected nose panel of 12 people sniffing engine exhaust diluted with purified air in known proportions. Because of different individual preferences for certain diesel exhaust odor types, measurements are made by matching the unknown exhaust odors with pyridine standards, chosen as better than standard, and more closely related to certain diesel exhaust odors. Simultaneously, odorous pollutants are analyzed by physico-chemical methods, flame ionization detection for unburned hydrocarbons, MBTH calorimetry for aldehydes, and liquid chromatography for LCO and LCS fractions following a modified procedure. First results show that the liquid chromatographic data fit neither better nor worse with sensory olfactory results on unburned hydrocarbons and aldehydes. A R H

N78-30376# Technischer Ueberwachungs-Verein Rheinland, e V Cologne (West Germany)

EXHAUST GAS EMISSION FACTORS IN THE MOTOR TRAFFIC FIELD THEIR IMPACT ON AIR POLLUTION CONTROL

E Plassmann /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 581-598

Avail NTIS HC A22/MF A01

Cadastral emission surveys, required by the German Federal Air Control Act of 1974 are discussed in relation to the total emissions from passenger cars and their impact on air quality. Road traffic in West Germany is shown to contribute to air pollution by releasing substances other than air constituents by noise emission, by impairing subsoil water and air during refueling operations, and by contributing scrap and waste materials which must be disposed on through some industrial process. A fleet of 100 passenger cars were tested to establish the 1975 reference year in respect to emission-specific parameters. Topics covered include (1) the driving mode test for description of road traffic (range and velocity), (2) driving modes for exhaust emissions

testing for passenger cars and (3) emissions and fuel consumption as functions of mean speed and as functions of the registration year of in-use cars
A R H

N78-30377# Billings Energy Research Corp Provo, Utah
HYDROGEN ENGINE NO_x CONTROL BY WATER INDUCTION

R L Wooley /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 598-608

Avail NTIS HC A22/MF A01

Water induction is an effective means of suppressing flashback and reducing nitrogen oxides in a hydrogen engine. Spraying water into the hydrogen stream prior to mixing with air is more effective than spraying it into the air/hydrogen mixture in the intake manifold. The level of nitrogen oxide production is an exponential function of several parameters: spark advance, equivalence ratio, and ratio of water to hydrogen mass flow rates. Excessive water is not detrimental to engine power and efficiency in the range of interest for automobile engines. A R H

N78-30378# Miami Univ, Fla
THE EFFECT OF METHANOL ADDITION TO GASOLINE ON TOTAL AND INDIVIDUAL HYDROCARBONS, METHANOL, AND FORMALDEHYDE EMISSIONS FROM A CARBURETTED SPARK IGNITION ENGINE

R D Doepker /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 608-609

Avail NTIS HC A22/MF A01

A four-cylinder, spark ignition carburetted engine was fueled with Indolene (gasoline) and 20 and 30 percent by volume blends of methanol-indolene. Reduced pressure sampling, followed by vapor phase chromatography techniques were utilized to determine qualitatively and quantitatively the composition of the exhaust emissions, including specific hydrocarbon species, methanol and formaldehyde. The light C sub 1 through C sub 5 hydrocarbons were also found to decrease with increasing blend level. Separation of these hydrocarbons into saturated and unsaturated hydrocarbons further demonstrate these observed decreases. These C sub 1 through C sub 5 hydrocarbons represent from 65 to 70 percent of the total hydrocarbon emissions on a gram/Hp-hr basis and over 85 percent on a moles/Hp-hr basis. Chemical composition of the C sub 1 through C sub 5 hydrocarbon fraction was independent of blend level but dependent on equivalence ratio. The C sub 6 through C sub 16 hydrocarbon emissions followed similar trends. A R H

N78-30380# Ultra Electronics, Ltd London (England)
PROGRAMMABLE CONTROLS A CONTROL ENGINEER'S DREAM

A N Thatcher /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems Vol 2 Feb 1978 p 627-647 ref

Avail NTIS HC A22/MF A01

Practical experience in the automotive gas turbine engine field demonstrates the ease of application and the flexibility of programmable analog controls. Because of the high level programming language and the consequent nonreliance on specialist programmers, the programmable analog controller (PAC) provides the facility for minimizing system development time. The unit, being production hardware, eliminates the cost of electronic circuit development. Applications of the PAC include Stirling cycle engine control system development, control of a complex steam valve arrangement for submarines and projected use as a control element in an auto-pilot system to enable accurate positional control of oil rig support vessels in bad weather situations. A R H

N78-30381# General Motors Technical Center, Warren Mich
AN ANALYTICAL STUDY OF TRANSMISSION MODIFICATIONS AS RELATED TO VEHICLE PERFORMANCE

H E Chana /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems Vol 2 Feb 1978 p 647-650

Avail NTIS HC A22/MF A01

A method of vehicle performance measurement developed so that selection of optimum fuel-economy-performance trade-offs can be made for a vehicle having various power train components was utilized in an analytical study of drive train component features such as overall ratio range, number of ratio steps, locked converters, continuously variable drives. Both manual and automatic type transmissions are considered. Indications are that ratio range is an important consideration in the selection of transmission design parameters, and also conventional transmission concepts can be competitive with the more exotic continuously variable type units. A R H

N78-30382# Little (Arthur D.), Inc Cambridge Mass
A STUDY TO VALIDATE AUTOMOBILE DRIVE TRAIN MODIFICATIONS THAT IMPROVE FUEL ECONOMY

Philip G Gott /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 650-651 refs

Avail NTIS HC A22/MF A01

Computerized simulation is used to validate computer predictions of the EPA urban and highway fuel economy improvements that can be achieved through the use of wide-range three- and four-speed automatic transmissions with and without torque converter lock-up. The impact of these transmissions on drivability, engine life, emissions and performance are also determined. A R H

N78-30383# Orshansky Transmission Corp San Diego Calif
DESIGN FACTORS OF HYDRO-MECHANICAL TRANSMISSIONS FOR PASSENGER CARS

Peter Huntley /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems Vol 2 Feb 1978 p 651-670

Avail NTIS HC A22/MF A01

A concept demonstration prototype hydromechanical transmission for US passenger cars contains a hydrostatic module consisting of 2 two pump/motor units mounted side by side on countershafts. The gearing, bulkheads, and large case required by the countershafts contribute substantially to the excessive weight of 62 kg in relation to current production automatic transmissions. Although the module is bulky, it satisfied the original EPA/ERDA requirement that it must package into the transmission tunnel of a US compact car. Continuously variable transmission features and specifications as well as potentials for fuel economy and noise reduction are discussed. A R H

N78-30384# Global Scientific Engineering Inc, Portland, Oreg
THE INERTIAL STORAGE TRANSMISSION

Vincent E Carman /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 671-672

Avail NTIS HC A22/MF A01

A simple energy storage system that utilizes pressurized oil as an energy storage medium is described. When the internal combustion engine (ICE) and the pump put out more oil than the drive motor requires for vehicle motion the excess is stored in the accumulator. When a pre-determined pressure is reached, the ICE shuts off. When pressure drops off, the pump is used as a starter motor and ICE restarts. Also, the drive motor is connected as braking pump and vehicle inertia is stored in the accumulator. This results in three means of energy saving: (1) the engine can be shut off instead of idling during deceleration, slow cruise, or when stopped; (2) a small engine (60 HP) and powerful drive motor (150 HP) can combine to give optimum performance in most instances with appreciable savings; and (3) the energy of a moving vehicle is not lost in heat during the braking cycle. A R H

**N78-30385# Volkswagen A G, Wolfsburg (West Germany)
THE EFFECT OF AERODYNAMIC DRAG ON THE FUEL
ECONOMY OF PASSENGER CARS**

Hans J Emmelmann /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 673-680 refs

Avail NTIS HC A22/MF A01

The relationship between fuel economy and aerodynamics for full size and subcompact cars is discussed. Gasoline-powered and diesel-powered synthesized cars were selected for an analysis using a computerized simulation program to predict fuel economy and performance with and without incorporation of aerodynamic improvements. The technique for realizing the desired aerodynamic improvements on cars is shown. By the so-called detail optimization method, a drag coefficient of $c_{sub} D = 0.42$ within a usual styling concept is achievable. With such optimized gasoline-powered cars maximum improvements in fuel economy referred to average 1977 cars of 7% for full size cars and 4% for subcompact cars are possible. By aerodynamic modification with a minimum assumed drag coefficient of $c_{sub} D = 0.32$, which implies a styling concept strongly influenced by aerodynamics, improvements in fuel economy of 14% for full size cars and 11% for subcompact cars are achievable. Values for diesel powered cars are included. A R H

**N78-30386# Transport and Road Research Lab, Crowthorne (England)
ENERGY FOR ROAD TRANSPORT IN THE UNITED
KINGDOM**

J Porter /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 681-685

Avail NTIS HC A22/MF A01

The use of computer simulation and instrumented cars to identify and evaluate potential energy conservation measures for the short-to-medium term is discussed. For the longer term, when natural crude oil becomes scarce and expensive, vehicles using synthetic gasoline from coal and battery vehicles will be used. These vehicles are compared and the factors needed to give a primary energy advantage of one type of vehicle over the other are examined as well as other considerations requiring assessment. A R H

**N78-30388# Harker Industries, Inc., Annandale, Va
COMBINING ENGINE COOLING WITH HEAT DRIVEN AIR
CONDITIONING TO IMPROVE AUTOMOTIVE FUEL
ECONOMY**

Alvin Lowi, Jr /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 691-696

Avail NTIS HC A22/MF A01

A format for evaluating the energy impact of automotive air conditioning and waste heat alternatives is presented. The conceptual design of one such alternative - an organic fluid engine cooling system combined with a novel jet-vapor-compression automotive air conditioning system - is described

and evaluated in comparison with the conventional belt-driven vapor compression system added on to the contemporary water-cooled power plant. The salient features of this Rankine bottoming cycle approach and some of its characteristics are also described. The value of shifting from a prime shaft-driven system to a hypothetical light-weight waste heat recovery system is determined for a single model year fleet. A potential reduction in the annual energy cost of automotive air conditioning usage of more than 70 percent is indicated, which is shown to be equivalent to the conservation of about 270 million barrels of crude oil over a ten-year period. A R H

**N78-30389# Wayne State Univ., Detroit, Mich
FLAME SPEEDS, PERFORMANCE, AND EMISSIONS WITH
METHANOL-INDOLENE BLENDS**

Naeim I Henein /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 697-706

Avail NTIS HC A22/MF A01

Methanol, added at different ratios to indolene, has various effects on combustion, performance and emissions in a CFR-SI engine. Flame speed is measured by fixed ionization probes and by a newly developed travelling ionization probe. The resulting turbulent flame speeds, computed laminar flame speeds, and the equivalent spherical flame speeds are analyzed to detect the turbulence decay over the cycle. The following effects were noted: increased octane number and brake specific fuel consumption, improved thermal efficiency, increased flame speed, increased BSCO and BSHC and decreased BSNOx emissions. Author

**N78-30390# Miami Univ., Fla
AUTOMOTIVE MATERIALS COMPATIBILITY WITH METH-
ANOL FUEL BLENDS**

LE Potest /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 707-711

Avail NTIS HC A22/MF A01

The effects of methanol on the materials in automobile fuel systems were investigated using several methanol/gasoline blends including blends with water to simulate moisture pick-up by the methanol. The conditions included ambient and elevated temperatures and with and without agitation. Evaluation was based on weight loss due to uniform corrosion and indications of pitting corrosion, stress corrosion, cracking, and galvanic corrosion. Methanol and methanol/gasoline blends increase the corrosion rates of most metals over the rates found in straight gasoline. Two areas of potential corrosion problems were determined. The most severe problem was the attack of methanol and methanol blends onterne plated steels. Methanol and methanol blends also produced severe pitting in aluminum. Agitation did not appear to have a marked effect on the rate of corrosion, and the difference in temperature from 70 F to 120 F did not make an appreciable difference in corrosion rates. A R H

**N78-30391# Volkswagen A G, Wolfsburg (West Germany)
RECENT PROGRESS IN AUTOMOTIVE ALCOHOL FUEL
APPLICATION**

Holger K Menrad /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 712-727

Avail NTIS HC A22/MF A01

Topics covered include: (1) biomass energy production of ethanol, (2) methanol synthesis, (3) fleet tests of Volkswagen vehicles using 15 volume % methanol mixture, (4) fleet tests using straight methanol or straight ethanol, (5) improved performance of spark ignition engines during bench tests using alcohols as fuel or components, (6) emissions, (7) prototype vehicles using pure methanol fuels, (8) properties of methanol/gasoline blends, and (9) the costs and energy values of methanol and ethanol fuels. A R H

**N78-30392# Research Inst for Road Vehicles, TNO, Delft (Netherlands)
ALTERNATIVE FUELS WITH REGARD TO LPG AND**

METHANOL

J VanDerWeide / In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems Vol 2 Feb 1978 p 727-730

Avail NTIS HC A22/MF A01

The increased use of LPG in many Western European countries as an automotive fuel in cars vans and taxis results from the long term availability of LPG from the North Sea where it exists in the form of an associated gas. The exhaust emissions produced in seven European cars each running on four different gasolines (lead-free low octane lead-free high octane, premium and regular) LPG and NG were compared. Favorable emission data obtained for LPG and NG are discussed. Strongly reduced exhaust emissions (which meet U.S. standards for 1978) and substantial noise reduction were obtained when LPG was used in city buses during demonstration projects in London Vienna, and Amsterdam. Cost calculations for large-scale operations are comparable to those for diesel vehicles. Experience with methanol as a fuel or blending component is less extensive. Its use as an alternative fuel in the Netherlands is discussed. A R H

N78-30393# Miami Univ Coral Gables Fla

THE EFFECT OF BLENDING METHANOL WITH GASOLINE ON GEOMETRIC DISTRIBUTION

R R Adt / In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems Vol 2 Feb 1978 p 730-732

Avail NTIS HC A22/MF A01

A four cylinder carbureted engine was fueled with Indolene (gasoline) and a blend of Indolene and 20 percent by volume methanol to determine the effect of the blend on geometric distribution. The engine parameters varied were engine speed manifold vacuum equivalence ratio, and simulated cruising speed. The results show that while both fuels, in general exhibited similar distribution patterns as a function of the engine parameters, the blend fueled mode of operation yielded a greater difference between the fuel-air equivalence ratios of the richest and leanest cylinders. Author

N78-30394# Energy Research and Development Administration, Bartlesville, Okla Energy Research Center

ALTERNATIVE FUELS THE OUTLOOK AND OPTIONS WITHIN THE NEXT DECADE

R W Hurn / In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 732-735

Avail NTIS HC A22/MF A01

A recent interagency governmental study group conclusion that automobile fuel to the year 2000 will be primarily conventional hydrocarbon liquids such as gasoline diesel fuel, or a combination of gasoline and distillate-type fuels narrows the issue for the primary fuel. However, highly significant questions remain concerning both the possible secondary supplemental fuels and the characteristics of the hydrocarbon type fuels. Such fuels as ammonia and hydrogen which require production distribution and engine fuel system technologies can be dismissed for the near-term. The current need is to identify those fuel forms their fuel characteristics and the compatible engines that may result from the utilization of solids for conversion to liquid fuels, as well as the adaption of new or upgraded engine technologies to achieve parallel objectives of low emissions and improved fuel economy. A R H

N78-30395# General Motors Research Labs, Warren, Mich
VEHICLE EVALUATION OF NEAT METHANOL COM-PROMISES AMONG EXHAUST EMISSIONS, FUEL ECON-OMY, AND DRIVEABILITY

N D Brinkman / In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 736-738

Avail NTIS HC A22/MF A01

Two cars one carbureted and the other fuel injected, were modified to burn neat methanol. Exhaust emissions fuel economy and driveability were measured and compared to those obtained

with gasoline in the unmodified (production) cars. Because acceptable driveability and durability were obtained only with the fuel injected car, it was used to investigate the spark timing and equivalence ratio settings which would give an acceptable compromise among exhaust emissions fuel economy and driveability. Average equivalence ratios of 0.96 to 0.62 and spark timing from best power to 15 degrees retarded were studied. With spark timing set for best power and the average equivalence ratio for maximum fuel economy (0.83) driveability was acceptable and CO and NOx emissions met the 1977 standards. However the unburned fuel emissions exceeded the 1977 standards for hydrocarbons even though the car was equipped with a catalytic converter. At 0.83 average equivalence ratio NOx emissions were reduced below the statutory standard (0.4) by retarding spark timing, however driveability and fuel economy deteriorated. Author

N78-30396# General Motors Research Labs, Warren, Mich
EVALUATION OF ACETYLENE AS A SPARK IGNITION ENGINE FUEL

D L Hilden / In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems Vol 2 Feb 1978 p 738

Avail NTIS HC A22/MF A01

Acetylene was evaluated in a single cylinder engine to investigate performance and emission characteristics with special emphasis on lean operation for NOx control. Testing was carried out at constant speed, constant airflow and MBT spark timing. Equivalence ratio and compression ratio were the primary variables. With acetylene the engine operated at equivalence ratios as lean as 0.53 and 0.43 for compression ratios of 4 and 6, respectively. However, the operating range was very limited. Knock-induced pre-ignition occurred either with compression ratios above 6 or with mixtures richer than 0.69 equivalence ratio. Both the indicated thermal efficiency and power output were less for acetylene fueling than for gasoline. Acetylene combustion occurred at sufficiently lean equivalence ratios to produce very low NOx and CO emissions. However, when the low NOx levels were achieved, hydrocarbon control was not improved over that with gasoline. A R H

N78-30398# Daimler-Benz, A G Stuttgart (West Germany)
CHARACTERISTICS OF A SINGLE-CYLINDER HYDROGEN-FUELED I C ENGINE USING VARIOUS MIXTURE FORMATION METHODS

K W Drexel and M Gutmann / In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 741-745

Avail NTIS HC A22/MF A01

Research work on hydrogen engines is survey. It is shown how the output of the engine depends on the mixture formation method used. Direct injection of hydrogen into the cylinder results in a gain in b.m.e.p. as compared with mixture formation in the intake pipe. The engine's operational parameters were set to reach minimum fuel consumption and minimum emissions. This involves combined quality/quantity-control and a compression ratio of 7.1 to avoid knocking at stoichiometric air/fuel-ratios. G Y

N78-30400# Toyota Motor Co Tokyo (Japan)
A STUDY ON REFORMED FUEL FOR AN AUTOMOTIVE GASOLINE ENGINE

K Onoda / In NATO Proc of the 4th Intern Symp on Automotive

Propulsion Systems, Vol 2 Feb 1978 p 759-768

Avail NTIS HC A22/MF A01

A prototype on-board fuel reformer was developed and laboratory tests were conducted to determine the effects of the amount of reformed fuel on combustion. The results of these tests are discussed in this paper. On the Japanese test cycle, an extremely low NO_x emission level was attained with relatively good fuel economy. However, in a limited combination of engine size and vehicle weight, engine power was sacrificed somewhat because of this lean combustion. A solution to this problem, while maintaining the lower NO_x emission level is to adopt a richer air-fuel ratio and a higher EGR rate. In this approach, the amount of hydrogen must be increased to improve combustion stability. For this purpose, methanol reforming was introduced whereby the additional hydrogen was supplied without any deterioration in energy efficiency. Author

N78-30401# Billings Energy Research Corp Provo Utah

A HYDROGEN-POWERED MASS TRANSIT SYSTEM

R L Wooley In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 768-773

Avail NTIS HC A22/MF A01

Hydrogen's application to mass transit systems is considered. A 21 passenger bus is converted to hydrogen using an engine which was modified for high compression operation. Backfiring and nitric oxide pollution formation are controlled by a water injection technique. Hydrogen fuel storage for the experimental prototype is accomplished by two metal hydride containers using an iron-titanium alloy. Data are presented regarding equipment conversion and design, energy resource utilization, economics, and safety. G Y

N78-30402# Billings Energy Research Corp Provo, Utah

REFUELING HYDROGEN TRANSIT FLEETS, PART A: ECONOMICS

R B Beyer In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 774-784 refs

Avail NTIS HC A22/MF A01

The economics of several hydrogen manufacturing, distribution, and use strategies are evaluated for a fleet of converted buses for the purpose of setting a guide in selection of feasible methods for refueling. The most attractive alternative is pipeline distribution of hydrogen produced from gasified coal and water for use in FeTi hydride vehicles. A system based on existing technology is estimated to cost midway between the current cost of gasoline (US) and the predicted cost of synthetic gasoline from coal. A hydrogen bus fleet supplied by pipeline will have a lower total cost than systems using other synthetic fuels derived from coal. G Y

N78-30404# Mueller Associates, Inc., Baltimore, Md

ALCOHOLS AND GASEOUS FUELS FROM BIOMASS

P W McCallum In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 789-795

Avail NTIS HC A22/MF A01

Bioconversion processes for the production of alcohols and gaseous fuels from biomass or organic plant and animal matter are discussed. An anaerobic digestion (fermentation) scheme is presented for the production of methane and ethanol from complex

organics and organic starches, respectively. The implications of the utilization of alcohols and gaseous fuels for transportation are discussed. G Y

**N78-30405# Transportation Systems Center, Cambridge, Mass
HYBRID HEAT ENGINE PROPULSION OF URBAN BUSES**

G Larson In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 795-802

Avail NTIS HC A22/MF A01

The developments to date in hybrid heat engine propulsion of buses are reviewed. Urban bus driving cycles and performance requirements are presented, based upon a survey of available urban bus driving patterns. Using these cycles and requirements, promising hybrid systems were sized through use of a vehicle propulsion simulation computational program. Both battery and flywheel energy storage subsystems were considered. The results of the hybrid study to date are reported. The heat energy simulated was a diesel. From the near-optimum hybrid propulsion system generated by the trade-off analysis, fuel economy and weight are presented and compared with values of present operational diesel buses negotiating the same driving cycles. A diesel/flywheel series configuration is projected to have at least a 100 percent increase in fuel mileage (mpg) over the baseline diesel bus fuel mileage. Author

**N78-30406# Volkswagen A.G., Wolfsburg (West Germany)
ELECTRIC AND HYBRID-VEHICLE POWER-TRAIN DEVELOPMENT**

J P Altendorf In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 803-822

Avail NTIS HC A22/MF A01

Prompted by air pollution from emissions from internal combustion engines there is a world-wide effort to find alternative power drive systems. Electric and hybrid drive systems constitute two possible alternatives. The characteristics of the two systems for use in motor vehicles is discussed. Comparisons of the two systems are made. Each power drive system is analysed by characterizing its components. Performance test data are given for an electric delivery truck and a hybrid bus. G Y

N78-30407# Wisconsin Univ. Madison

EXPERIMENTAL EVALUATION OF A FLYWHEEL ENERGY MANAGEMENT AUTOMOBILE

N H Beachley In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 822-829

Avail NTIS HC A22/MF A01

Based on detailed computer simulations and optimization studies, a flywheel-IC engine hybrid automobile was constructed and experimentally evaluated. The power plant consists of a engine with electronic fuel injection, an energy-storage flywheel in an evacuated housing, a continuously variable transmission (CVT) based on the hydrostatic power-split principle, and the necessary controls and instrumentation. Road testing, chassis dynamometer runs and component tests were conducted to experimentally evaluate the driveability, the control, and the fuel saving potential of the concept and to verify the computer simulation models. G Y

N78-30408# ESB, Inc. Yardley, Pa

FLYWHEEL ELECTRIC MOTOR HYBRID POWER TRAIN FOR ELECTRIC VEHICLES

G C Kugler In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 829-845

Avail NTIS HC A22/MF A01

The performance of an automotive power source can be described using two parameters: energy storage capacity and power output capability. The total amount of usable energy determines the vehicle's range under defined driving profiles, while the maximum power output or the rate of energy utilization limits the maximum dynamic performance capabilities such as rate of acceleration and grade climbing ability. Specific power

(watts/lbs) and specific energy (watt-hours/lb) requirements of a battery used to power an electric vehicle with certain performance envelopes is shown. The hypothetical vehicle weight, 2000 lbs., has a rolling friction of 35 lbs., and an aerodynamic coefficient of 0.60, a frontal area of 20 sq ft., and a battery weight of 500 lbs. It is concluded that the only battery system that will be economically available for the next half decade in high quantity production is lead acid. G Y

N78-30409# Fiat Research Center, Orbassano (Italy)

FIAT ELECTRIC CITY CAR PROTOTYPE

G Brusaglino /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems Vol 2 Feb 1978 p 846-854

Avail NTIS HC A22/MF A01

Electric vehicles represent an important research activity. One of the themes was the development of a two city car prototype with properly designed body. The main purpose was to define a vehicle capable of meeting the multiple requirements of a comfortable and easy driving - handling - parking, and suitable performance for urban operation in level or hilly routes. The general concept is in accordance with a near term solution of the electrical power equipment, both for propulsion and on-board storage systems. The propulsion system consists in a separately excited high specific power d.c. motor fed by transistor double chopper. An Ni-Zn battery was provided for on-board storage equipment. Author

N78-30410# Exxon Enterprises, Inc., New York

COMPARATIVE EFFICIENCIES OF ALTERNATIVE FUTURE AUTOMOTIVE POWER SYSTEMS

G P Fetterman /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 855-864

Avail NTIS HC A22/MF A01

An analysis of the overall energy efficiency of a small (2 + 2) urban vehicle powered by five different power trains, all with similar acceleration performance and payload capabilities is presented. The drive trains compared are a hydrogen-fueled-spark-ignition engine, an advanced gasoline-fueled-spark-ignition engine, diesel engine, a diesel/electric hybrid, and a pure electric with an advanced motor/controller and battery. The test weight of each vehicle is varied so that differences in both power system weight and chassis weight propagation are reflected. Each vehicle is mathematically modeled and driven over the EPA urban driving cycle so that its road load energy requirements are generated. The energy usage of each vehicle is then traced through its drive train and fuel processing efficiencies and measured in terms of raw energy in the ground. Estimates are made of the energy used in the production of each vehicle, and the total life cycle energy consumption is calculated. Author

N78-30411# California Univ., Livermore Lawrence Livermore Lab

THE FLYWHEEL-BATTERY HYBRID POWER SYSTEMS: A CONCEPT TO IMPROVE ELECTRIC VEHICLE PERFORMANCE

D D Davis /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 864-876

(CONF-770430-2) Avail NTIS HC A22/MF A01

The benefits to be gained through the use of the flywheel in conjunction with improved and advanced batteries predicted for development over the next decade are examined. In addition to the state of the art lead-acid battery, the advanced lead-acid, nickel-zinc, and lithium-iron sulfide systems with 1980-85 development goals are examined as prime power sources for a flywheel-battery hybrid system. In order to illustrate the improvements in range to be realized through the flywheel addition, a four-passenger commute vehicle was chosen as a baseline design. The vehicular model was used to calculate the range of all-battery or hybrid powered baseline vehicles. Range comparisons between the all-battery and hybrid vehicles are made with the vehicles operating at constant velocity and according to a cyclic pattern representative of urban driving. G Y

N78-30413# General Research Corp Santa Barbara Calif
PERFORMANCE STANDARDS FOR ELECTRIC VEHICLES

J Brennand /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems Vol 2 Feb 1978 p 891-901

Avail NTIS HC A22/MF A01

The rationale leading to recommendations for specific performance standards for near-term and advanced electric vehicles which are to be leased or purchased by the U.S. Energy Research and Development Administration is set forth. The underlying analytical basis is derived. Performance standards include ranges from 50 km (J227a/C, near-term private vehicles) to 150 km (J227a/D, advanced private vehicles). Energy consumption maximum at the input to the charger are 0.25 and 0.2 kWh/km for the private vehicles (near-term and advanced) and 0.45 and 0.35 kWh/km for commercial vehicles. Author

N78-30414# AiResearch Mfg Co., Los Angeles Calif

BATTERY-FLYWHEEL POWER SYSTEM FOR AN URBAN AUTOMOBILE

B H Rowlett /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 902-913

Avail NTIS HC A22/MF A01

The work being done under contract to the Energy Research and Development Administration is described. The flywheel supplies the energy for all of the high power requirements, which results in good vehicle acceleration characteristics, the combination of regenerative braking and load leveling of the battery current results in improved range of the vehicle. G Y

N78-30415# AiResearch Mfg Co., Los Angeles Calif

A NEW LOOK AT FLYWHEEL PROPULSION FOR URBAN TRANSIT BUSES

L J Lawson /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 913-930 refs

Avail NTIS HC A22/MF A01

A comparative analysis of operational performance, energy efficiency, and lifecycle costs was made of four flywheel propulsion systems in contrast with three baseline vehicles (standard diesel bus, electric trolley coach and battery bus). The four flywheel propulsion systems are (1) a pure flywheel system, (2) a flywheel/battery hybrid system, (3) a flywheel/diesel engine hybrid system and (4) a flywheel-augmented trolley coach. The analysis results show that all four flywheel propulsion configurations have sufficient advantages to remain as candidates for planned design studies. Author

N78-30416# California Univ., Livermore Lawrence Livermore Lab

THEORETICAL PERFORMANCE UPGRADING OF THE EVA ELECTRIC VEHICLE BY USE OF A FLYWHEEL/BATTERY HYBRID POWER TRAIN SYSTEM

R C Epps /In NATO Proc of the 4th Intern Symp on Automotive Propulsion Systems, Vol 2 Feb 1978 p 930-942

(CONF-770430-3) Avail NTIS HC A22/MF A01

Performance data for advanced batteries as well as the current state of the art lead-acid battery are shown. The all-electric drive train was theoretically replaced by a hybrid system (flywheel addition) of equal weight and performance and range were evaluated. The vehicle model was used to calculate and compare vehicle performance of the all-electric drive to that of hybrid power system. Test results indicate a rather dramatic improvement in range for the hybrid powered vehicle especially when operating in accordance with the cyclic schedule which represents urban driving conditions. G Y

N78-30475# Rice Univ., Houston, Tex

IONOSPHERE/MICROWAVE BEAM INTERACTION STUDY Final Report

Wm E Gordon and Lewis M Duncan Jul 1978 53 p refs
(Contract NAS9-15212)
(NASA-CR-151821) Avail NTIS HC A04/MF A01 CSCL
20N

The microwave beam of the Solar Power Satellite (SPS) is predicted to interact with the ionosphere producing thermal runaway up to an altitude of about 100 kilometers at a power density threshold of 12 mW/cm sq (within a factor of two). The operation of the SPS at two frequencies, 2450 and 5800 MHz is compared. The ionosphere interaction is less at the higher frequency but the tropospheric problem scattering from heavy rain and hail is worse at the higher frequency. Microwave signals from communication satellites were observed to scintillate but there is some concern that the uplink pilot signal may be distorted by the SPS heated ionosphere. The microwave scintillations are only observed in the tropics in the early evenings near the equinoxes. Results indicate that large phase errors in the uplink pilot signal can be reduced. S E S

**N78-30499# Battelle Pacific Northwest Labs., Richland Wash
ELECTROMAGNETIC COMPATIBILITY, TROPOSPHERIC
AND IONOSPHERIC ASPECTS OF SPS MPTS OPERA-
TIONS**

Mar 1978 40 p refs
(Contract EW-78-1-06-1071)
(PNL-2616) Avail NTIS HC A03/MF A01

The results of a preliminary study of the effects of operation of a Solar Power Satellite (SPS) on the general performance of terrestrial and space based electromagnetic systems are given. In addition the effects of a passing high energy Microwave Power Transmission System (MPTS) through the troposphere and through the ionosphere are also considered. Study topics include (1) the susceptibility of electronic equipment to SPS emission, (2) the interference potential of SPS emission and harmonics to electromagnetic systems, (3) the impact of tropospheric attenuation and scattering associated with SPS operation on microwave terrestrial, air/ground and satellite/ground telecommunication systems, (4) the production of ionospheric irregularities resulting from microwave heating, and (5) impact of SPS operation on the telecommunication system performance collected in conjunction with a microwave heating experiment.

ERA

**N78-30590# Energy Research and Development Administration,
Bartlesville Okla
INVESTIGATION OF FUEL ECONOMY POTENTIAL OF FOUR
1977 MODEL VEHICLES**

R L Bechtold and R D Fleming 1977 10 p refs Presented
at Passenger Car Meeting, Detroit 26-30 Sep 1977 sponsored
by SAE
(CONF-7709103-1) Avail NTIS HC A02/MF A01

A vehicle testing program was conducted to determine the inherent fuel economy potential of current (1977) technology engines given freedom to optimize engine adjustment for best fuel economy with no constraint on engine-out emissions. The average city/highway fuel economy of four car models with optimized air-fuel ratio and spark timing was improved by 4.1% as compared to the fuel economy of the baseline values found for the vehicles with air-fuel ratio and spark timing at manufacturer's specifications.

ERA

**N78-30595*# National Academy of Sciences - National Research
Council, Washington, D C Federal Construction Council
STATIONARY DIESEL ENGINES FOR USE WITH GENERA-
TORS TO SUPPLY ELECTRIC POWER**

1977 37 p
(Contracts NASw-2988 EA-77-C-01-2641
N00025-77-C-0001 GS-00-B-871)
(PB-280112/4, TR-69) Avail NTIS HC A03/MF A01 CSCL
21G

The procurement of stationary diesel engines for on-site generation of electric power deals with technical criteria and policy relating to federal agency not electrical components of diesel-generator sets or for the design of electric-power generating plants or their air-pollution or noise control equipment. GRA

**N78-30636*# Jet Propulsion Lab Calif Inst of Tech Pasadena
A CLOSED NETWORK QUEUE MODEL OF UNDERGROUND
COAL MINING PRODUCTION, FAILURE, AND REPAIR**

G M Lohman 15 Aug 1978 52 p refs Sponsored by DOE
(Contract NAS7-100)
(NASA-CR-157554, JPL-Pub-78-72) Avail NTIS
HC A04/MF A01 CSCL 081

Underground coal mining system production, failures and repair cycles were mathematically modeled as a closed network of two queues in series. The model was designed to better understand the technological constraints on availability of current underground mining systems, and to develop guidelines for estimating the availability of advanced mining systems and their associated needs for spares as well as production and maintenance personnel. It was found that mine performance is theoretically limited by the maintainability ratio. Significant gains in availability appear possible by means of small improvements in the time between failures. The number of crews and sections should be properly balanced for any given maintainability ratio and main haulage systems closest to the mine mouth require the most attention to reliability. S B S

**N78-30641# Energy Research and Development Administration
Laramie, Wyo Energy Research Center
THERMAL ANALYSIS ON OIL SHALE DETERMINATION
OF POTENTIAL OIL YIELDS AND DAWSONITE, NAHCOL-
ITE, AND NORDSTRANDITE CONTENT**

Donald R Johnson N B Young and J W Smith 1977 20 p
refs
(LERC/R-77/6) Avail NTIS HC A02/MF A01

Thermal analysis was applied to Green River Formation oil shales to demonstrate the method's capabilities for estimating oil yields and for determining dawsonite, nahcolite, and nordstrandite. A single sample heated in thermal analysis apparatus incorporating differential thermal analysis and thermogravimetry will produce quantitative data on the three oil shale minerals and excellent oil yield estimates. Coefficients of determination ranged from 0.88 for dawsonite and nordstrandite determinations to 0.998 for nahcolite. Requirements to be met by thermal analysis equipment to obtain accurate oil shale compositional data are outlined. The method is especially useful where minerals are encountered that interfere with other analytical techniques. ERA

**N78-30643# California Univ Berkeley Lawrence Berkeley
Lab
NORTHERN NEVADA GEOTHERMAL EXPLORATION
STRATEGY ANALYSIS**

N E Goldstein Dec 1977 58 p
(Contract W-7405-eng-48)
(LBL-7012) Avail NTIS HC A04/MF A01

The results of exploration techniques applied to geothermal resource investigations in northern Nevada were evaluated and rated. A quantitative rating scheme was used to obtain estimates of technique effectiveness. From survey cost information cost-effectiveness estimates for the various techniques were also obtained and compared. Effectiveness estimates were used to develop an exploration strategy for the area. However, because no deep confirmatory drilling has been done yet the technique evaluations and exploration strategy must be considered as preliminary. The strategy was further studied by means of a decision tree analysis merging the strategy with the timing of land acquisition and deep drilling to find the scenario that gives the highest cost-effectiveness values for drilling success overall project success, and maximum expected returns on exploration investment. Based on assumed probabilities it is shown that land acquisition should be deferred until after the basic detail-phase exploration is completed. The cost effectiveness of the initial confirmatory drill hole will be a maximum when land acquisition is followed by a supplemental detail-phase program, but this approach does not lead to the highest expected return on investment. ERA

N78-30653 Oklahoma State Univ. Stillwater
TRANSIENT BEHAVIOR OF WIND DRIVEN SYNCHRONOUS MACHINES Ph.D Thesis

Abdul Qawi Qazi 1977 156 p
 Avail Univ Microfilms Order No 7811064

The transient behavior of wind driven synchronous machines under conditions of wind gusts and faults for various system configurations were investigated and design recommendations from the view point of electrical stability and energy delivered to the utility grid were made. This task was performed in the following steps (1) formulate the mathematical model for each identified and selected system configuration (2) solve the sets of non-linear differential equations by employing an appropriate numerical technique and digital simulation, (3) present the results in the form of curves (4) interpret these curves (5) draw some useful conclusions and (6) suggest areas for future research
 Dissert Abstr

N78-30654*# IBM Federal Systems Div Huntsville, Ala
SYSTEM INTEGRATION OF MARKETABLE SUBSYSTEMS Second Collection of Progress Reports

Jul 1978 68 p Prepared for DOE
 (Contract NAS8-32036)
 (NASA-CR-150742) Avail NTIS HC A04/MF A01 CSCL 10A

These monthly reports covering the period February 1978 through June 1978, describe the progress made in the major areas of the program. The areas covered are systems integration of marketable subsystems development design and building of site data acquisition subsystems, development and operation of the central data processing system operation of the MSFC Solar Test Facility and systems analysis
 S B S

N78-30658*# Barry (Theodore) and Associates Los Angeles Calif

SAMICS MARKETING AND DISTRIBUTION MODEL

Apr 1978 109 p refs Prepared for JPL and DOE
 (Contract NAS7-100, JPL-954905)
 (NASA-CR-157552 DOE/JPL-954909-78/2) Avail NTIS HC A06/MF A01 CSCL 10A

A SAMICS (Solar Array Manufacturing Industry Costing Standards) was formulated as a computer simulation model. Given a proper description of the manufacturing technology as input, this model computes the manufacturing price of solar arrays for a broad range of production levels. This report presents a model for computing these marketing and distribution costs, the end point of the model being the loading dock of the final manufacturer
 G Y

N78-30659*# Lockheed Missiles and Space Co., Sunnyvale Calif Electrical Power Systems Dept
STUDY OF SEP SOLAR ARRAY MODIFICATIONS Final Report

G J Antonides 14 Jul 1978 57 p refs
 (Contracts NAS7-100 JPL-995070)
 (NASA-CR-157403 LMSC-D573788) Avail NTIS HC A04/MF A01 CSCL 10A

The feasibility of modifying the solar electric propulsion (SEP) 66 watt/kilogram, 12.5 kilowatt solar array blanket design to incorporate ultra-low mass blanket technology and to generate conceptual design data by modifying the SEP solar array design to 17.5kW power output was performed. Five modified designs were developed which substituted present SEP solar array design components with one or more of 50 micron thick solar cells, 75 micron cell coverglasses, and a different blanket substrate developed by GE. A parametric analysis was performed to determine the solar array mass least weight and blanket tension required to maintain a minimum natural frequency of 0.04 Hz. The solar array wing assembly weights and power outputs were calculated and preliminary cost estimates for flight hardware development fabrication and qualification were made for each case studied
 S E S

N78-30660*# IBM Federal Systems Div Huntsville, Ala
SIMS PROTOTYPE SYSTEM 3 TEST RESULTS ENGINEERING ANALYSIS

Aug 1978 70 p

(Contract NAS8-32036)

(NASA-CR-150758) Avail NTIS HC A04/MF A01 CSCL 10A

The results obtained during testing of a closed hydronic drain down solar system designed for space and hot water heating is presented. Data analysis is included which documents the system performance and verifies the suitability of SIMS Prototype System 3 for field installation
 L S

N78-30663*# Jet Propulsion Lab Calif Inst of Tech Pasadena
SITING ISSUES FOR SOLAR THERMAL POWER PLANTS WITH SMALL COMMUNITY APPLICATIONS

J J Holbeck and S J Ireland 20 Jul 1978 49 p refs
 Sponsored by DOE

(Contract NAS7-100)

(NASA-CR-157559 JPL-Pub-78-75 DOE/JPL-1060-78/2)
 Avail NTIS HC A03/MF A01 CSCL 10B

Technologies for solar thermal plants are being developed to provide energy alternatives for the future. Implementation of these plants requires consideration of siting issues as well as power system technology. While many conventional siting considerations are applicable, there is also a set of unique siting issues for solar thermal plants. Early experimental plants will have special siting considerations. The siting issues associated with small dispersed solar thermal power plants in the 1 to 10 MWe power range for utility/small community applications are considered. Some specific requirements refer to the first 1 MWe engineering experiment for the Small Power Systems Applications (SPSA) Project. The siting issues themselves are discussed in three categories: (1) system resource requirements, (2) environmental effects on the system, and (3) potential impact of the plant on the environment. Within these categories, specific issues are discussed in a qualitative manner. Examples of limiting factors for some issues are taken from studies of other solar systems
 S E S

N78-30664# Naval Civil Engineering Lab Port Hueneme, Calif
SOLAR HEATING OF BUILDINGS AND DOMESTIC HOT WATER Final Report, Jul 1974 - Dec 1975

E J Beck Jr and R L Field Nov 1977 88 p refs Revised (YF57571999)

(AD-A054601 CEL-TR-835) Avail NTIS HC A05/MF A01 CSCL 03/2

The purpose of this document is to provide guidance in the design and cost analysis of solar heating systems for buildings and domestic hot water (DHW). The nature of solar radiation, several types of solar systems, storage devices and architectural considerations are among topics included. Calculation methods are included for determining collector size, storage size, simplified building and DHW loads, value of fuel saved and saving-investment ratios. The calculation procedure is based on parametric curves for fraction of heating load supplied by solar energy and several rules of thumb for design. A series of 11 worksheets is used to enable the engineer with no prior experience with solar systems to accomplish a complete design and cost analysis. With this information he can prepare bidding and specification documents for the job. Tables of solar insolation at various Navy stations, typical building heat loads, collector prices by type and storage tank prices are included. Two example problems are worked for tube-in-sheet collectors: one for space and DHW heating for a single dwelling and the other DHW supply for a dispensary. Neither was found to be cost effective when competing against present day prices for natural gas. A directory of manufacturers and bibliography is also included.

Author (GRA)

N78-30667# Argonne National Lab Ill
ADVANCED FUEL CELL DEVELOPMENT Progress Report, Apr - Jun 1977

J P Ackerman, K Kinoshita, J W Sim, R Swaroop and P A Nelson Aug 1977 22 p refs

(Contract W-31-109-eng-38)

(ANL-77-56) Avail NTIS HC A02/MF A01

Efforts were directed toward understanding and improvement of molten-carbonate-electrolyte fuel cells operating at temperatures near 923 K. A primary focus of the work was on developing electrolyte structures which have high strength and conductivity, as well as good electrolyte retention and on developing methods of synthesis for electrolyte structures that are amenable to mass production. A low temperature synthesis which produces material having rodlike particles of beta-LiAlO₂ was refined and is now used for preparing electrolytes. Cell testing is essential for understanding and evaluating individual component behavior and the interactions of the components under realistic operating conditions. Most of the testing to date was conducted in a 7-cm (2 3/4-in)-dia cylindrical cell with Type 316 stainless steel housings and current collectors, a nickel anode and a nickel oxide cathode. ERA

**N78-30668# Tennessee Valley Authority Muscle Shoals Ala
EVALUATION OF INTERMEDIATE-Btu COAL GASIFICATION
SYSTEMS FOR RETROFITTING POWER PLANTS
Final Report**

D A Waitzman, H Faucett, D E Nichols, S V Tomlinson, and W J Broadfoot. Aug 1977. 126 p. refs. Sponsored by Electric Power Research Inst. (EPRI-AF-531). Avail. NTIS HC A07/MF A01.

Process and economic evaluations were made of two different intermediate-Btu coal gasification systems retrofitted to an existing electric power unit. One of the systems uses fixed-bed oxygen-blown Lurgi gasifiers for sized coal (coal fines are sold as a byproduct) with a tar and oil cleanup, hydrogen sulfide removal and sulfur recovery processes. The other system uses entrained-bed gasifiers which gasify the coal including fines, with a hydrogen sulfide removal and sulfur recovery process. Using a prescribed set of representative power unit process design and economic premises, a base case (500 MW 35% S in coal existing unit) incorporating the latest available technology was defined for each system including a complete material balance, equipment list and construction and operating requirements. Capital investment, annual revenue requirements (7,000 hr/yr) and lifetime revenue requirements (over a 25-yr declining operating profile) were estimated for the base case of each system. ERA

**N78-30669# RCA Advanced Technology Labs Camden, N J
TECHNICAL AND ECONOMIC FEASIBILITY OF THERMAL
STORAGE Final Report**

B Shelpuk, P Joy and M Crouthamel. Jun 1977. 118 p. refs. (Contract EY-76-C-02-2591). (COO/2591-76/1). Avail. NTIS HC A06/MF A01.

Various thermal energy storage alternatives were compared for performance and annualized cost which result from each storage alternative operating with the same solar collector model, the same building load model and the same heating system and controls model. Performance and cost calculations were made on the basis of an hour-by-hour time step using actual weather bureau data for Albuquerque, N M, and New York City for a single six-month heating season. The primary conclusion is that using current costs for materials and containers, water is the cheapest storage alternative for heating applications in both Albuquerque and New York City. The cost of containing or encapsulating phase change materials, coupled with their small system performance advantage is the main reason for this conclusion. The use of desiccant materials for thermal storage is considered to be impractical due to irreversibilities in thermal cycling. ERA

**N78-30670# Oak Ridge National Lab Tenn
ALTERNATE OPERATING CONDITIONS AND SYSTEMS
FOR THE COAL-FIRED MODULAR INTEGRATED UTILITY
SYSTEM**

G Samuels and W M Wells. Feb 1978. 54 p. refs. (Contracts W-7405-eng-26 EX-76-A-01-1742). (ORNL/HUD/MIUS-46). Avail. NTIS HC A04/MF A01.

An analysis is made to determine the effects of varying the operating conditions of a coal-fired closed-cycle gas turbine modular integrated utility system on the efficiency and cost of

the plant and to evaluate the merits of using an organic Rankine system for this application either as a single cycle or in combination with the gas turbine system. The electrical efficiency and overall fuel utilization of the reference gas turbine plant were severely degraded by reducing the turbine inlet temperature. The electrical efficiency was reduced about two points for each 100 F (56 K) reduction in temperature with little if any change in the cost of the plant over a temperature range from 1500 to 1200 F (1089 to 922 K). A single cycle organic Rankine system was not well suited for this application and would, at best, be very marginal. The addition of an organic Rankine secondary cycle to the gas turbine system offered the potential for significant improvements in both efficiency and cost over that of the reference gas turbine plant. ERA

**N78-30673# Argonne National Lab Ill
PROSPECTS FOR OPEN-CYCLE MHD PLANTS**

M Petrick and W C Redman. 1977. 27 p. refs. Presented at the Am Inst of Chem Engr Symp on Alternate Processes for Clean Generation of Electric Power from Coal. New York. 16 Nov 1977.

(Contract W-31-109-eng-38).

(CONF-771102-20). Avail. NTIS HC A03/MF A01.

Technical problems to be solved and economic promise vis-a-vis other advanced systems for electrical power generation are assessed. The bases for a reduced environmental impact are explained. Ongoing programs for the development of coal-fired plants are reviewed. ERA

**N78-30674# Brookhaven National Lab Upton, N Y Technology
Assessment Group**

ENERGY USE IN JAPAN AND THE UNITED STATES

A Doernberg. Aug 1977. 73 p. refs.

(Contract EY-76-C-02-0016).

(BNL-50713). Avail. NTIS HC A04/MF A01.

This comparative study was undertaken to explain in part the per capita differential between the two countries. In the introduction, the ratios of energy per capita and energy per dollar of gross domestic product (GDP) are presented. The exchange rates utilized to convert GDP to a common currency are discussed. Brief sections on the energy supply and electric generation situation in Japan are included for background information, followed by the energy consumption sectors. The industrial sector merits most attention because Japan's industrial capacity is second only to that of the U.S. among industrialized nations and it is here where an intercountry comparison can reveal possibilities of technology transfer. A gross energy efficiency indicator for all industry (measured as industrial energy use per dollar of GDP originating in industry) is established. ERA

**N78-30675# Illinois Univ, Urbana Survey Research Lab
PUBLIC REACTIONS TO WIND ENERGY DEVICES
Final Report**

Oct 1977. 215 p. Sponsored in part by DOE.

(Grant NSF APR-75-22213).

(NSF/RA-770026). Avail. NTIS HC A10/MF A01.

Reactions of the general public toward different types of wind energy devices for generating electric energy were explored. More specifically, the objectives were twofold: to provide substantive information on public acceptance of different types of wind energy devices in different settings and to furnish a methodological base for more intensive studies of public acceptance of such devices. Personal interviews with statistical random samples of adults in six different parts of the country were conducted with primary emphasis on rural and smaller urban areas. The locations selected were western Michigan, southeastern Wyoming, western Washington, eastern Rhode Island, the Chicago area and the Sandy Hook Unit of the Gateway National Recreation Area in New Jersey. Those interviewed were questioned on a number of topics including their attitudes toward their opinions on paying extra for pollution-free sources of energy. In addition, they were shown slides of different wind energy machines in various settings and were asked to indicate their preferences from an aesthetic point of view. ERA

N78-30677# Arkla Industries, Inc. Evansville, Ind
UNITARY SOLAR HEATING/COOLING SYSTEM PACKAGE DEVELOPMENT Progress Report, 1 Jun 1977 - 31 Jan. 1978

R H Merrick 1978 20 p
 (Contract EG-77-C-02-4593)
 (COO/4593-1) Avail NTIS HC A02/MF A01

During this period, a 3 ton residential system hardware package was developed and is operating in an Arkla owned solar house in Evansville. The Arkla tower-cooled WF36 chiller was substituted for the evaporatively cooled chiller under development in the package. The residential software and manufacturing programs are underway. ERA

N78-30678# Department of Energy Washington, D C
GUIDE TO SOLAR ENERGY PROGRAMS
 Mar 1978 72 p

(DOE/ET-0036) Avail NTIS HC A04/MF A01

The mission and objectives of the U S Department of Energy (DOE) are outlined. An overview of DOE's solar energy programs is given, including (1) the solar thermal power systems program (2) the photovoltaic systems program, (3) the fuels from biomass program, (4) the ocean thermal systems program, and (5) the wind energy systems program. Also, the environmental and resource assessment program and the satellite power system program are described. Solar energy programs now functioning under the Division of Conservation and Solar Applications are described, including the solar technology transfer program and the thermal applications program. Methods of procurement and guides for proposal preparation and sources of solar energy information and activities supporting the solar energy program are discussed. Author (ERA)

N78-30680# Sheet Metal and Air Conditioning Contractors National Assoc. Vienna Va
FUNDAMENTALS OF SOLAR HEATING Correspondence Course

Jan 1978 176 p refs
 (Contract EG-77-C-01-4038)

(HCP/M4038) Avail NTIS HC A09/MF A01

This correspondence course contains the following lessons: solar heating and cooling, solar radiation, solar collectors, heat storage, control devices and specialty items, sizing solar system components, operation of solar heating systems, domestic water heating, heating system installation, servicing, and legal responsibilities. Author (ERA)

N78-30682# Stuttgart Univ (West Germany) Inst fuer Flugzeugbau
WIND POWER

Ulrich Huetter 1977 4 p. In GERMAN. Presented at Energy Policies Forum, Stuttgart, 9-12 May 1977.

(AED-Conf-77-139-004) Avail NTIS (US Sales Only) HC A02/MF A01, DOE Depository Libraries

A survey is presented of the possibilities to utilize wind power in the FRG. Wind power plants could meet about 70% of the electricity demand (approximately 200 TWh) on the basis of figures of 1973. Interconnected operation between wind power converters and solar energy collectors for supplying remote properties or villages seems particularly promising. ERA

N78-30683# Booz-Allen Applied Research, Inc., Bethesda, Md
STANDARD CRITERIA FOR THE ECONOMIC EVALUATION OF ALTERNATIVE PIPELINE AND FUEL GAS DEMONSTRATION PLANT DESIGN CONCEPTS Final Task Report
 Sep 1977 42 p

(Contract EX-76-C-01-2343)

(FE-2343-42, Task-042) Avail NTIS HC A03/MF A01

The recommended procedures for comparative economic evaluations of demonstration plants are primarily that a base case economic analysis performed in accordance with specified assumptions and procedures, to be part of the proposal is required, and specific economic data elements be provided for use in a computerized economic analysis performed by analysts. This course of action will provide uniformly developed base case

analyses which can be used with a high degree of comparability among projects. Moreover, the submission of specified data elements will enable analysts to perform sensitivity studies without significantly increasing the requirements. Recommendations, plus supplemental analyses are presented to provide a sound framework for making economic comparisons between alternative plant design concepts. ERA

N78-30684# Foster Wheeler Corp., Livingston, NJ
DESIGN REPORT VOLUME 1. PROCESS DESIGN DEVELOPMENT WORK FOR AN ADVANCED COAL GASIFICATION SYSTEM FOR ELECTRIC POWER GENERATION FROM COAL DIRECTED TOWARD A COMMERCIAL GASIFICATION GENERATION PLANT, PHASE 2

Oct 1977 324 p refs

(Contracts EX-76-C-01-1521, E(49-18)-1521)

(FE-1521-20-Vol-1) Avail NTIS HC A14/MF A01

The status of a design for a pilot plant to gasify 20 t/h of coal in an entrained flow gasifier and produce low-Btu gas for power generation in a combine cycle is summarized. The pilot plant is designed to obtain the technology required to build commercial coal gasification/combined cycle power plants. To minimize problems which might interfere with achievement of these objectives, sections of the pilot plant auxiliary to the gasifier were designed to use available, commercially proven processes and equipment wherever possible. ERA

N78-30685# Oak Ridge National Lab Tenn Chemical Technology Div
SUPPORT RESEARCH AND DEVELOPMENT ON SEPARATIONS TECHNOLOGY Final Report

B R Rodgers, S Katz, and P R Westmoreland Oct 1977 92 p refs

(Contract W-7405-eng-26)

(ORNL/TM-5843) Avail NTIS HC A05/MF A01

Separations technology was studied for coal conversion systems. Alternative methods for accomplishing the solid liquid separations that are required for liquefaction processes were examined. Phase II characterization tests of selected process streams and scouting tests for some alternate separations methods were carried out. Bench-scale development of agglomeration settling separations techniques, verification of methods to significantly improve process filtration rates, and selected characterization and aging tests were also surveyed. ERA

N78-30686# Oak Ridge National Lab Tenn
STEADY-STATE COMPOSITION PROFILES IN MIXED MOLTEN SALT BATTERY AND FUEL CELL ANALOGS

C E Vallet and J Braunstein 1977 22 p refs. Presented at ANS Winter Meeting, San Francisco, 22 Nov 1977.

(Contract W-7405-eng-26)

(CONF-771109-67) Avail NTIS HC A02/MF A01

Steady state equations were derived for composition gradients in battery and fuel cell analogs with binary mixtures of molten salts as electrolytes. Conditions of current density, electrode separation, electrolyte composition, temperature, ion mobilities and electrode reaction are presented that favor steady state, precipitation of a solid phase, or depletion of an ionic constituent at an electrode. ERA

N78-30687# Oak Ridge National Lab Tenn
RESIDENTIAL ENERGY USE TO THE YEAR 2000 A REGIONAL ANALYSIS

E Hirst and J B Kurish Nov 1977 50 p refs

(Contract W-7405-eng-26)

(ORNL-CON-17) Avail NTIS HC A03/MF A01

The effects of residential energy conservation programs in each of the ten Federal regions are evaluated. The programs considered are those proposed in the National Energy Plan: appliance efficiency targets, thermal standards for construction of new residences and weatherization of existing housing units. Implementation of these programs might cut cumulative (1977-2000) national residential energy use by 41 Qbtu. Relative

energy savings are highest in Regions 7 and 8 (11 and 10% respectively, of their baselines) and smallest in Region 9 (7%). The net economic benefit to the nation's households of these three Federal programs is \$21 billion. Benefits exceed costs in each region; the benefit/cost ratio ranges from a low of 1.4 in Region 10 to a high of 2.0 in Region 6. ERA

N78-30688# National Energy Information Center, Washington, D C
THE 1977-1978 HEATING SEASON. PROJECTED NATURAL GAS CURTAILMENTS AND POTENTIAL NEEDS FOR ADDITIONAL ALTERNATE FUELS
 Nov 1977 116 p refs. Sponsored by DOE
 (DOE/EIA-0015) Avail NTIS HC A06/MF A01

Curtailments of natural gas requirements for end-use customers at the national level during the 1977-1978 heating season (November-March) are projected to be 1.83 trillion cubic feet (Tcf). These projected curtailments are 60 billion cubic feet (Bcf) or 3 percent lower than projections made for the 1976-1977 season with both projections based on assumptions of normal winter weather. Projected gas curtailments at the national level for the 1977-1978 heating season are 155 Bcf lower than the actual curtailments reported for the 1976-1977 heating season. The higher curtailments last season were influenced by colder-than-normal winter weather that occurred in many states east of the Mississippi River and in the upper Midwest. Reasons for changes in curtailments, projections of curtailments by type of customer, local areas subject to gas curtailments problems, availability of alternate fuels and estimated magnitude of additional costs of substituting alternate fuels for curtailed gas volumes are given. ERA

N78-30689# Colorado State Univ., Fort Collins Dept of Atmospheric Science
EFFECT OF ATMOSPHERIC VARIABILITY ON ENERGY UTILIZATION AND CONSERVATION. SUMMARY OF RESEARCH. Technical Progress Report, 1 Nov. 1976 - 31 Jul 1977

E R Reiter, B R Johnson, B C MacDonald, W L Somervell, Jr., and A M Starr. Sep 1977 71 p refs.
 (Contract EY-76-S-02-1340)
 (COO-1340-55) Avail NTIS HC A04/MF A01

Various feedback mechanisms between the oceans and the atmosphere were examined. Several of these mechanisms appear to be the cause of the interannual variability of the atmosphere's general circulation and of climatic changes on a time scale of several tens of years. Specifically, a recent cooling-trend in the North Pacific north of 40°N, and sea surface temperature fluctuations with an irregular periodicity of 2 to 4 years superimposed upon this trend were examined. To advance regional long-range forecasting skills, January temperature anomalies over the eastern United States were correlated with flow patterns over the U.S. and Canada. The space heating energy consumption model for Greeley, Colorado, for the winter of 1976-77 was within 98.9 percent of actual natural gas consumption for that city. ERA

N78-30693# Nevada Bureau of Mines and Geology, Reno
SUMMARY REPORT OF AVAILABILITY OF GEOTHERMAL DATA FOR POTENTIAL DIRECT HEAT APPLICATION IN NEVADA

D T Trexler. Sep 1977 12 p.
 (Contract EY-76-S-08-0671)
 (NVO/0671-1) Avail NTIS HC A02/MF A01

An assessment of available data on geothermal springs and wells was performed by first ascertaining which agencies both State and Federal maintain files which have water temperatures. The principal files are maintained by the Nevada Bureau of Mines and Geology, U.S. Geological Survey and Water Resources Center-Desert Research Institute. The State Engineer's office maintains files of driller's logs. Requirements for completing driller's logs under subsection 5 states water temperature will be reported, if thermometer is unavailable an estimated temperature will be given as cold, warm or hot. The second phase of the assessment of available data to determine the quality of the

data in each file was performed by inventory of files and by cross-correlating files by cursory examination. An estimate of the number of entries in the Nevada Bureau of Mines and Geology (NBMG) file with inferred temperatures that could be associated with confidence to replace data was also made. ERA

N78-30694# Energy Research and Development Administration, Washington, D C Div of Solar Energy
ERDA FACILITIES SOLAR DESIGN HANDBOOK
 Aug 1977 178 p refs.
 (ERDA-77-65) Avail NTIS HC A09/MF A01

This handbook covers design of solar heating systems for commercial and laboratory buildings at Energy Research and Development Facilities. It includes discussions of solar energy fundamentals, solar heating and cooling technology, systems and components, as well as a discussion of solar system economics. Quantitative analysis with generalized design and sizing curves, is presented for solar heating so that collector and other system parameters can be cost economically sized without a computer simulation. Solar system design considerations and guidelines, as well as guidelines for developing subsystem specifications, are presented. Thus, this handbook is both a primer for the solar novice and a reference manual for the solar system designer. ERA

N78-30695# Oak Ridge Y-12 Plant, Tenn
DEVELOPMENT OF THE BANDWRAP FLYWHEEL
 C E Knight Jr, J J Kelly, R L Huddleston and R E Pollard
 1977 20 p refs. Presented at the Flywheel Technol Symp
 San Francisco 5-7 Oct 1977
 (Contract W-7405-eng-26)

(Y/DA-7290 Conf-771053-3) Avail NTIS HC A02/MF A01
 The development of the first test flywheel is described. The flywheel design uses a thick rim element and unidirectional fiber composite bands which pass around the rim diameter and across a metal hub fitted to the drive shaft. The individual bands are meshed together at the hub and function similar to spokes on a wheel. The design is called the 'bandwrap' flywheel. In the development process, conceptual designs were selected for detailed study. After detailed study the bandwrap design was selected for fabrication and test. After fabrication, the flywheel was spun to 18,000 rpm where where a predicted delamination occurred in the rim. At this speed, the energy stored was 0.25 kwh and the energy density was 10.1 Wh/lb. ERA

N78-30696# Oak Ridge Y-12 Plant, Tenn
ANALYSIS OF THE DELTAWRAP FLYWHEEL DESIGN
 C E Knight, Jr. 1977 9 p refs. Presented at the Flywheel Technol Symp. San Francisco 5-7 Oct 1977
 (Contract W-7405-eng-26)

(Y/DA-7292 Conf-771053-6) Avail NTIS HC A02/MF A01
 An extension of the 'bandwrap' design is discussed. A model and computer program developed calculates the thickness and elastic properties versus position on the overwrap. The thickness is calculated based on coverage per band, number of bands, and band thickness at a given radial coordinate. The elastic properties are derived assuming the overwrap material to be modeled by the properties of an angle ply laminate. The thickness and properties provide input to a finite element model. A linear elastic finite element analysis provides an estimate of the energy storage potential for this design. The model was two dimensionally axisymmetric and was analyzed using the ADINA finite element program. ERA

N78-30697# California Univ., Livermore Lawrence Livermore Lab

ENERGY AND TECHNOLOGY REVIEW
 R W Selden, ed, H D Shay, ed, R B Crawford, ed, K L Cummings, ed, and J T Staehle, ed. Jun 1977 35 p.
 (Contract W-7405-eng-48)
 (UCRL-52000-77-6) Avail NTIS HC A03/MF A01

A pool-type reactor used in research on radiation damage and a quasi-electric drive vehicle to help reduce petroleum use

are described in a review of energy technology. Windpower on Oahu, Hawaii, to develop methods of documenting and predicting wind energy in mountainous regions was also studied. B B

N78-30699# California Univ., Livermore. Lawrence Livermore Lab.

UTILIZATION OF FLYWHEELS FOR THE EVOLUTION OF HIGH-PERFORMANCE ELECTRIC VEHICLES

L G O'Connell, J F Cooper, A B Miller and H W Newkirk. 19 Oct 1977. 16 p. refs.

(Contract W-7405-eng-48)

(UCRL-52346) Avail NTIS HC A02/MF A01

The performance of current and future electric vehicles is examined and compared with that of projected heat engine vehicles. The shortcomings of electric vehicles in the near future are also discussed. It is predicted that the all-electric vehicle, even those utilizing flywheels to meet transient power demands, will not gain wide acceptance in the near future because of degraded performance characteristics. It is indicated that the flywheel always improves performance and range under certain circumstances. Therefore, a hybrid concept that can increase performance in the near future is examined. This type of vehicle is a much-needed transition system to provide an evolutionary change from the heat engine vehicle of today to future electric vehicles with acceptable performance. ERA

N78-30700# California Univ., Livermore. Lawrence Livermore Lab.

INFLATED CYLINDRICAL SOLAR CONCENTRATOR FOR PRODUCING INDUSTRIAL PROCESS HEAT

J W Gerich. 14 Oct 1977. 23 p. refs. Sponsored by DOE (UCID-17612). Avail NTIS HC A02/MF A01

The use of industrial process heat below 170 C accounts for 5% of this country's total energy consumption. A concentrating solar collector to produce hot water and steam in this temperature range is under development. The collector structure consists mainly of an inflated thin film plastic cylinder that is clear on the upper portion and is an aluminized reflector on the lower portion. The reflector concentrates sunlight on a receiver tube which is jacketed with a heat transfer suppressing, thin film plastic cylinder. Because of its simplicity, it is believed this collector will be cost effective relative to fossil fuels such as oil at \$15/bbl. Computer codes were written to analyze the optical and thermal properties of this collector. Results indicate that weekly tilting of the collector provides over 90% of the energy available from continuous tracking. A selective surface on the receiver tube increases the useful energy gain by more than a factor of five at 170 C. ERA

N78-30701# Department of Energy, Washington, D C. **METHODOLOGICAL ASPECTS OF ESTIMATING THE EFFICIENCY OF UTILIZATION OF FUEL AND ENERGY RESOURCES**

R B Akhmedov. [1977]. 17 p. refs. Transl. into ENGLISH of Report from All-Union Sci. Res. Inst. of Complex Fuel and Energy Probl. State Planning Comm. of the USSR, Moscow, 1977 (DOE-TR-25). Avail NTIS HC A02/MF A01

The economy of the Soviet Union is developing on the basis of utilization of its own fuel and energy resources (FER). This is an important advantage of the Soviet economy and one of the prerequisites for its stable growth. However, in order to make full use of this advantage, it is necessary to utilize the available FER as efficiently as possible. This means that the actual demand for various types of fuel and energy in all the branches of the national economy must be satisfied with minimum total national economic expenditures on the prospecting, extraction, processing, conversion, distribution, and utilization of the energy resources. A methodological basis for planning measures aimed at raising the efficiency of FER utilization and conservation includes the identification and study of existing reserves of FER economy, and technical and economic justification of the sequence, periods, scales, and branch and territorial structure of their realization. Depending on the planning period of a measure, various methods of study were used. Some specific data were used to show calculation methods. Author (ERA)

N78-30702# Energy Research and Development Administration, Washington, D C.

HYDROTHERMAL ENERGY SYSTEMS FY 1977 ENVIRONMENTAL DEVELOPMENT PLAN (EDP)

R R Loose and H R Wasson. Jun 1977. 92 p.

(EDP/G-01(77)) Avail NTIS HC A05/MF A01

This plan identifies the environmental, health, safety, social, and economic (EH and S) issues which are associated with the development, demonstration, and commercialization of hydrothermal resources and conversion technology, and the ERDA actions required to resolve them. These actions may include the initiation of R and D activities, operations monitoring, baseline characterization studies, or activities leading to the development of EH and S standards and criteria in concert with other responsible agencies. Hydrothermal energy development program, environmental, health, and safety issues, and environmental program are discussed. Titles of the four appendices are: forecast guide for active geothermal development areas; discussion of environmental issues; environmental research supporting the resolution of environmental issues; and elements of the hydrothermal environmental projects. ERA

N78-30703# Institute for Energy Analysis, Oak Ridge, Tenn. **CAN THE SUN REPLACE URANIUM?**

Alvin M Weinberg. Jul 1977. 31 p. refs.

(ORAU/IEA(M)-77-2) Avail NTIS HC A03/MF A01

Two asymptotic worlds, one based on solar energy, the other based on nuclear energy, are compared. The total energy demand in each case is 2,000 quads. Although the sun can, in principle, supply this energy, it probably will be very expensive. If the energy were supplied entirely by breeders, the nuclear energy system would pose formidable systems problems--particularly safety and proliferation. It is suggested that in view of these possible difficulties, all options must be kept open. ERA

N78-30704# National Conference of States on Building Codes and Standards, Inc., McLean, Va.

MODEL CODE FOR ENERGY CONSERVATION IN NEW BUILDING CONSTRUCTION

Dec 1977. 86 p. refs.

(Contract EY-76-C-03-1230)

(SAN/1230-1) Avail NTIS HC A05/MF A01

A model code for energy conservation in building construction was developed, setting forth the minimum regulations found necessary to mandate such conservation. The code addresses itself to the administration, design criteria, systems elements, controls, service water heating and electrical distribution and use, both for depletable and nondepletable energy sources. The document is intended for use by state and local building officials in the implementation of a statewide energy conservation program. ERA

N78-30705# National Technical Information Service, Springfield, Va.

THERMIONIC ENERGY CONVERSION, VOLUME 1. A BIBLIOGRAPHY WITH ABSTRACTS. Final Report, 1970 - May 1977

William E Reed. Jun 1978. 301 p.

(NTIS/PS-78/0590/6) Avail NTIS HC \$28.00/MF \$28.00 C\$CL 10B

Research on thermionic power generation, power plant design, converter design, and basic research on thermionic materials are cited in the bibliography. Spacecraft applications are included. (This updated bibliography contains 296 abstracts, none of which are new entries to the previous edition.) GRA

N78-30706# National Technical Information Service, Springfield, Va.

THERMIONIC ENERGY CONVERSION, VOLUME 2. A BIBLIOGRAPHY WITH ABSTRACTS. Final Report, Jun 1977 - May 1978

William E Reed. Jun 1978. 67 p. Supersedes NTIS/PS-77/

0527, NTIS/PS-76/0389, NTIS/PS-75/372

(NTIS/PS-78/0591/4, NTIS/PS-77/0527, NTIS/PS-76/0389)

NTIS/PS-75/372 COM-73-11692) Avail NTIS
HC \$28 00/MF \$28 00 CSCL 10B

A bibliography containing 62 abstracts concerning research on thermionic power generation, power plant design, converter design, and basic research on thermionic materials is presented
GRA

N78-30708# General Accounting Office Washington, D C
Energy and Minerals Div

**SOLAR DEMONSTRATIONS ON FEDERAL RESIDENCES-
BETTER PLANNING AND MANAGEMENT CONTROL
NEEDED**

14 Apr 1978 16 p
(PB-279700/9, EMD-78-40) Avail NTIS HC A02/MF A01
CSCL 10A

This report is a review of an attempt to demonstrate the practical use of solar heating on Federal residences and makes recommendations to avoid a recurrence of problems encountered
GRA

N78-30709# National Inst of Building Sciences Washington,
D C

**ENERGY CONSERVATION STANDARDS FOR BUILDINGS
STATUS OF STATES' REGULATORY ACTIVITIES**

15 Feb 1978 32 p
(Contract HUD-H-2822-RG)
(PB-279936/9, HUD/RES-1331) Avail NTIS
HC A03/MF A01 CSCL 10A

A directory of the state executive offices with responsibility for energy conservation and buildings standards under the divisions of (1) energy policy (2) Standards Administration (3) Standards Enforcement, and (4) Building Codes and Standards is reported
GRA

N78-30710# Environmental Law Inst Washington D C
**LEGAL AND INSTITUTIONAL PERSPECTIVES ON SOLAR
ENERGY IN COLORADO A CASE STUDY OF LAND USE
AND ENERGY DECISION-MAKING Final Report**

Karrn H Hillhouse, Ellen E Kohler, Richard A Liroff and Alan
S Miller Nov 1977 243 p
(Grant NSF APR-75-18247)
(PB-279994/8, NSF/RA-770336) Avail NTIS
HC A11/MF A01 CSCL 10A

Colorado's institutional and regulatory structure relevant to an emerging energy technology is considered Topics covered include (1) an examination of the potential effect of federal jurisdiction over matters relevant to solar utilization (2) an analysis of a number of Colorado's incentives proposed and implemented, that might encourage solar applications and build a solar assessment capability into the state's energy planning institutional structure, (3) development of these considerations with specific attention to utility regulations and to land use planning for solar utilization, and (4) an examination of the general appeal of solar systems by exploring energy literature and social and architectural history
GRA

N78-30711# ARI Foundation Inc Arlington Va
**ORGANIZATION OF CERTIFICATION PROGRAM FOR
SOLAR COLLECTORS Final Report**

G R Munger and Robert J Evans 30 Nov 1977 99 p
(Contract NBS-7-35734)
(PB-280025/8, NBS/GCR-78/125) Avail NTIS
HC A05/MF A01 CSCL 10A

Proposed documentation is presented for the operation of a solar collector certification program The documents included are a Equipment Rating Standard, a Certification Program Operational Manual, a Certification Laboratory Contract and a Manufacturer's License Agreement Also provided are a typical calendar for the initiation of a program and an estimate of the first annual budget for a certification program
GRA

N78-30717# Battelle Pacific Northwest Labs, Richland, Wash
**IMPACT OF INCREASED COAL CONSUMPTION IN THE
PACIFIC NORTHWEST**

J B Burnham, comp Mar 1978 327 p refs
(Contract EY-76-C-06-1830)
(BNWL-RAP-21) Avail NTIS HC A15/MF A01

Environmental, health and socioeconomic impacts to be expected from the increased use of coal were identified Mitigation strategies that might be used to manage these impacts were investigated A number of energy issues were identified Probably the most significant issues in this region are the siting of coal-fired power plants and the tradeoff in water allocation between energy and agriculture Choices of coal-fired generation sites and water use determine the level of impacts to air, water land, terrestrial and aquatic ecosystems, and human health and socioeconomic Air quality impacts were studied by incorporating current and projected emission inventories into both short-range and long-range air quality diffusion models Results indicate that annual average ambient air quality standards will not be exceeded at any of the sites
ERA

N78-30718# Washington State Univ, Pullman Thermal Energy
Lab
**INORGANIC POLLUTANTS FROM PULVERIZED COAL
COMBUSTION, A REVIEW**

Philip C Malte Oct 1977 26 p refs Presented at Fall
Meeting of the Western States Section of the Combust Inst,
Palo Alto, Calif, 17 Oct 1977
(Contract EX-76-C-01-2252)
(USS/CI-77-48, Conf-771015-16) Avail NTIS
HC A03/MF A01

A review of inorganic pollutants in coal classifies them according to affinity with other major inorganic mineral components (sulfides, sulfates carbonates, etc) or affinity with the organic coal The latter elements are B Br and Ge and, in some coals Be Ga, Sb, Ti, U and V Most elements have a lower concentration in coal than in the surrounding rocks but a few are more concentrated in the coal (As Cl, B and especially Se) During combustion some of the calcium and other alkali metal compounds appear to tie-up a portion of the sulfur in the coal as sulfates (and thus reduce the air pollution by SO₂), if the combustion temperature is not too high Fly ash formation is also discussed and the tendency of the more volatile elements (or their compounds) to be concentrated on the submicron particle sizes Finally, several elements in the ash are recommended for special attention because of possible toxic effects on terrestrial systems, as a result of air pollution or leaching from ash disposal sites
ERA

N78-30719# Argonne National Lab, Ill
**ENVIRONMENTAL CONTROL STRATEGIES FOR COAL-
FIRED PLANTS: A COMPARATIVE EVALUATION**

C D Livengood, Paul S Farber, and Samuel H Wong 1977
9 p refs Presented at the 5th Ann Energy and Environ Conf,
Cincinnati, 3 Nov 1977
(Contract W-31-109-eng-38)
(CONF-7710101-6) Avail NTIS HC A02/MF A01

The implications of environmental control technologies for the coal-to-electricity process are assessed from a detailed engineering and cost point of view Comparative evaluations of their efficacies were made from a total system viewpoint, taking into account different geographic, environmental, and regulatory constraints The focus was on control of airborne emissions by presently available technology The results point out that there are usually several cost-competitive routes to achieving compliance with existing regulations
ERA

N78-30720# Institute for Energy Analysis, Oak Ridge, Tenn
**ATMOSPHERIC CO₂ CONSEQUENCES OF HEAVY DE-
PENDENCE ON COAL**

R M Rotty Dec 1977 39 p refs
(Contract EY-76-S-05-033)
(ORAU/IEA-M-77-27) Avail NTIS HC A03/MF A01

Increases in the atmospheric concentration of CO₂ cause concern only when the quantities become large--i.e several hundred billion tons of additional carbon The direct contribution

from emphasis on coal use through 1985, as called for in the U.S. National Energy Plan is of minor consequence. On the other hand if such a policy continues into the next century, or if it serves as a model for major segments of the world then the quantity of resulting CO₂ could have serious consequences early in the next century. Further if coal is used on a large scale as the base for liquid and/or gaseous synthetic fuels as the oil and natural gas reserves are depleted the inefficiencies of conversion would serve to increase the CO₂ produced per unit of delivered energy and further aggravate the problem. ERA

N78-30722# Brookhaven National Lab., Upton, N.Y. Economic Analysis Div

LONG-TERM ECONOMIC AND ENVIRONMENTAL CONSEQUENCES

David J. Behling, Jr., William Marcuse, Joan Lukachinski, and Robert Dullien. Jun 1977. 102 p. refs. Presented at ORSA/TIMS Meeting, San Francisco, May 1977.

(Contract EY-76-C-02-0016)

(BNL-22735, Conf-770526-4) Avail NTIS HC A06/MF A01

Potential energy economic and environmental impacts that would result from a policy decision to halt any further construction of nuclear power plants were studied. Wherever possible, each modeling group used the same set of model input parameter values to estimate the impacts. The analysis was based on the use of an integrated modeling system, the long-term interindustry transactions model, the Brookhaven dynamic energy system optimization model, and several groups of interface equations. The model system is first described and then used to estimate four alternative energy economic and environmental futures. In the Base Case scenario, it was assumed that growth in the nuclear sector will not be constrained by safety or security considerations so that, when economical, nuclear reactors will build up at reasonable rates including advanced uranium and breeder reactors, starting in 2000. ERA

N78-30731# Alabama Univ., University Coll. of Engineering. **SITE SELECTION AND DESIGN FOR MINIMIZING POLLUTION FROM UNDERGROUND COAL MINING OPERATIONS** Final Report, Jun 1974 - Dec 1976

Reynold Q. Shotts, Eric Sterett, and Thomas A. Simpson. Jan 1978. 111 p. refs.

(Contract EPA-68-03-2015)

(PB-280180/1 EPA-600/7-78-006)

Avail NTIS

HC A06/MF A01 CSCL 13B

The objectives of how best to select a layout and mining system were examined and also to develop and operate an underground coal mine while at the same time minimizing pollution of the environment. The pre-mining environment was assessed by sampling Cedar Creek 3 and other streams. Analyses of samples of groundwater into the mine of the water pumped from the mine sump, and of water from Cedar Creek below the mine, made possible the assessment of the area with regard to water quality. Principal factors associated with mining which affected downstream water quality were sulfide oxidation and acid formation in the mine, the quality of the groundwater seeping into the mine, the limestone used for rock dusting, and the quality of the resettled but not treated mine and washing plant water carried to the continuous miners for dust suppression. Deep mines in Alabama's synclinal coalfields, if entered some distance from the outcrop, or mined down-dip if started on the outcrop, should produce little surface pollution. GRA

N78-30736# Pacific Northwest Environmental Research Lab., Corvallis, Ore.

THE BIOENVIRONMENTAL IMPACT OF A COAL-FIRED POWER PLANT, COLSTRIP, MONTANA, DECEMBER 1977 Interim Report

Eric M. Preston and Robert A. Lewis. Feb 1978. 531 p. refs. (PB-280326/O, EPA-600/3-78-021, IR-3) Avail NTIS HC A23/MF A01 CSCL 13B

The EPA has recognized the need for a rational approach to the incorporation of ecological impact information into power facility siting decisions in the northern great plains. Research funded by the Colstrip, Coal-fired Power Plant Project is a first attempt to generate methods to predict the bioenvironmental effects of air pollution before damage is sustained. Pre-construction documentation of the environmental characteristics of the grassland ecosystem in the vicinity of Colstrip, Montana began in the summer of 1974. Since then, key characteristics of the ecosystem were monitored regularly to detect possible pollution impacts upon plant and animal community structure. In the summer of 1975, field stressing experiments were begun to provide the data necessary to develop dose-response models for SO₂ stress on a grassland ecosystem. These experiments involve continuous stressing of one acre grassland plots with measured doses of SO₂ during the growing season (usually April through October). Results of the 1975 field season's investigations are summarized in this publication. The six-year project will terminate in 1980 and a final report will be published after data analyses are complete. GRA

N78-30746 California Univ., Berkeley. **MICROSEISMS IN GEOTHERMAL EXPLORATION STUDIES IN GRASS VALLEY, NEVADA** Ph.D. Thesis

Alfred Liang-Chi Liaw. 1977. 188 p.

Avail Univ. Microfilms Order No. 78-12658

Frequency-wavenumber (f-k) spectra of seismic noise measured at several places in Grass Valley, Nevada, exhibited numerous features which were correlated with variations in surface geology and sources associated with hot spring activity. Exploration techniques for geothermal reservoirs, based upon the spatial distribution of the amplitude and frequency characteristics of short-period seismic noise, were applied and evaluated. A detailed investigation of the spatial and temporal characteristics of the noise field was made to guide subsequent data acquisition and processing. A small two-dimensional array was placed at 16 locations in the region to map propagation parameters. The f-k spectra reveal local shallow sources, but no evidence for a significant body wave component in the noise field was found. With proper data sampling, array processing provides a powerful method for mapping the horizontal component of the vector phase velocity of the noise field. Dissert. Abstr.

N78-30784# Wyoming Univ., Laramie. **LOCATING AREAS OF HIGH WIND-ENERGY POTENTIAL BY REMOTE OBSERVATION OF EOLIAN GEOMORPHOLOGY AND TOPOGRAPHY**

Ronald W. Marrs and J. Marwitz. 1977. 23 p. refs. Presented at 3d Biennial Wind Energy Conversion Systems Conf., Washington, D.C., 19 Sep 1977.

(Contract EY-76-S-06-2343)

(RLO/2343-5 Conf-770921-5) Avail NTIS HC A02/MF A01

An area in central Wyoming was chosen as the test site. The site contained many well-developed eolian landforms and was noted for its high winds. While some members of the research team interpreted satellite imagery and aerial photos and gathered field data in regions of dunes and blowouts, others compiled all available climatic information and collected additional data via low altitude flights with a specially instrumented aircraft. Observed characteristics of eolian features were then correlated with the wind data. Cause-and-effect interrelationships were identified and theoretical models were tested as possible explanations to the observed relationships. Relationships which proved useful in the Wyoming test area were then applied over a broader region and in other areas of the country to test for regional applicability of each predictor. ERA

N78-30940# RCA Labs., Princeton, N.J.

GRANULAR OPTICAL MATERIALS Final Report, 1 Jan 1975 - 31 Dec 1977

J. Gittleman and E. K. Sichel. 28 Feb 1978. 61 p. refs.

(Contract F44620-75-C-0057 AF Proj 2306)
(AD-A054099 PRRL-78-CR-8, AFOSR-78-0714TR) Avail
NTIS HC A04/MF A01 CSCL 20/6

The research under this contract has been directed mainly toward the understanding of the optical behavior of those composite materials whose components are separated on a scale that is very small (~ 100 Å) compared with the wavelength of light. In the course of this work two types of new materials have been developed (1) semiconductor-insulator composites which may be valuable as selective absorbers of solar radiation in solar thermal applications and (2) electrochromic cermetes which may have applications in a variety of display devices. Comparison of the predictions of two theories -- the Maxwell-Garnett theory (MG) and the effective-medium theory -- with the observed optical behavior of cermetes formed by cosputtering a metal and an insulator clearly favored the MG theory. The optical properties of most Au, Ag, and W cermetes were at least qualitatively described by MG and good quantitative agreement could be obtained in most cases by modifying the published values of the optical constants of the metals to take into account the very short electron-scattering times found in the cermetes. The most notable exception was Au-MgO which did not exhibit the dielectric anomaly. GRA

N78-30952# Bechtel Corp San Francisco Calif
LASER FUSION-FISSION REACTOR SYSTEMS STUDY.
4000 MW LASER FUSION HYBRID REACTOR

Jan 1977 70 p

(Contract W-7405-eng-48)

(UCRL-13796) Avail NTIS HC A04/MF A01

A hybrid reactor with a sodium-cooled depleted uranium fission blanket and liquid lithium tritium breeding fusion blankets is the central point in a laser fusion-fission reactor power plant. Driven by a selenium gas laser the reactor produces a total of 4000 MWt. This energy is transferred by sodium and lithium coolant systems to steam generators. The thermal energy in the steam is then converted to electrical energy by a modified light water reactor (LWR) steam turbine generator system. A gross electrical output of 1520 MWe is attained. The net electrical output varies between 1195 and 1232 MWe depending upon the changing multiplication of energy in the reactor and the complementary consumption of power by the laser system. Topics covered include (1) reactor design, (2) laser system, (3) power plant concept (4) environment and safety (5) economics, and (6) design options. ERA

N78-30959# Oak Ridge National Lab Tenn
ECONOMIC EVALUATION OF TOKAMAK POWER PLANTS

R L Reid and D Steiner 1977 23 p refs Presented at the IAEA Conf and Workshop on Fusion Reactor Design Madison Wis 12 Oct 1977

(Contract W-7405-eng-26)

(CONF-771056-3) Avail NTIS HC A02/MF A01

The impact of plasma operating characteristics engineering options and technology on the capital cost trends of Tokamak power plants is examined. Tokamak power systems are compared to other advanced energy systems and found to be economically competitive. A three-phase strategy for demonstrating commercial feasibility of fusion power, based on a common-site multiple-unit concept is presented. ERA

N78-31076# Committee on Science and Technology (U S House)

FUTURE NEEDS AND OPPORTUNITIES IN THE AIR TRAFFIC CONTROL SYSTEM

Washington GPO 1977 716 p refs Hearings before Subcomm on Transportation, Aviation and Weather of the Comm on Sci and Technol, 95th Congr 1st Sess, 8-9, 14-16 Jun 8 Sep 1977

(GPO-98-931) Avail Subcomm on Transportation, Aviation and Weather

Testimony concerning the philosophies and issues related to future or post third generation air traffic control (ATC) systems is presented. Research and development programs, microwave landing systems, wind shear, wake vortex, availability of energy, and the economic climate are among the factors considered. Emphasis is placed on the enhancement of system capacity, safety and productivity. Aviation demands of the public are projected through the turn of the century in terms of expansion of ATC services. JMS

N78-31085*# Lockheed-California Co, Burbank
STUDY OF FUEL SYSTEMS FOR LH2-FUELED SUBSONIC TRANSPORT AIRCRAFT, VOLUME 1 Final Report, Sep 1976 - Dec 1977

G D Brewer R E Morris, G W Davis, E F Versaw, G R Cunningham Jr (Lockheed Missiles and Space Co, Inc), J C Riple (AirResearch Mfg Co) C F Baerst (AirResearch Mfg Co), and G Garmong (Rocketdyne) Jul 1978 202 p 2 Vol (Contract NAS1-14614)

(NASA-CR-145369-Vol-1 LR-28384-Vol-1) Avail NTIS HC A10/MF A01 CSCL 01C

Several engine concepts examined to determine a preferred design which most effectively exploits the characteristics of hydrogen fuel in aircraft tanks received major emphasis. Many candidate designs of tank structure and cryogenic insulation systems were evaluated. Designs of all major elements of the aircraft fuel system including pumps, lines, valves, regulators, and heat exchangers received attention. Selected designs of boost pumps to be mounted in the LH2 tanks, and of a high pressure pump to be mounted on the engine were defined. A final design of LH2-fueled transport aircraft was established which incorporates a preferred design of fuel system. That aircraft was then compared with a conventionally fueled counterpart designed to equivalent technology standards. Author

N78-31086*# Lockheed-California Co, Burbank
STUDY OF FUEL SYSTEMS FOR LH2-FUELED SUBSONIC TRANSPORT AIRCRAFT, VOLUME 2 Final Report, Sep. 1976 - Dec 1977

G D Brewer R E Morris, G W Davis, E F Versaw, G R Cunningham Jr (Lockheed Missiles and Space Co, Inc), J C Riple (AirResearch Mfg Co), C F Baerst (AirResearch Mfg Co), and G Garmong (Rocketdyne) Jul 1978 356 p refs 2 Vol (Contract NAS1-14614)

(NASA-CR-145369-Vol-2) Avail NTIS HC A16/MF A01 CSCL 01C

For abstract, see N78-31085

N78-31108*# General Electric Co Cincinnati Ohio Aircraft Engine Group

ENERGY EFFICIENT ENGINE. PRELIMINARY DESIGN AND INTEGRATION STUDIES Final Report, Jan 1977 - Apr 1978

R P Johnston, R Hirschkron C C Koch, R E Nertzel, and P W Vinson Sep 1978 417 p refs (Contract NAS3-20627)

(NASA-CR-135444, R78AEG510) Avail NTIS HC A18/MF A01 CSCL 21E

Parametric design and mission evaluations of advanced turbofan configurations were conducted for future transport aircraft application. Economics, environmental suitability and fuel efficiency were investigated and compared with goals set by NASA. Of the candidate engines which included mixed- and separate-flow direct-drive and geared configurations, an advanced mixed flow direct-drive configuration was selected for further design and evaluation. All goals were judged to have been met except the acoustic goal. Also conducted was a performance risk analysis and a preliminary aerodynamic design of the 10 stage 23:1 pressure ratio compressor used in the study engines. Author

N78-31143* Raytheon Co., Wayland, Mass. Microwave and Power Tube Div
DESIGN, FABRICATION AND TESTING OF A CFA FOR USE IN THE SOLAR POWER SATELLITE Final Report
 William C Brown Aug 1978 152 p refs
 (Contract NAS3-20374)
 (NASA-CR-159410, PT-5228) Avail NTIS HC A08/MF A01 CSCL 22B

A crossed field amplifier was designed to meet the performance objectives of high signal to noise ratio an efficiency of 85%, a CW microwave power output of 5-8 kW, and a frequency of 2450 MHz. The signal to noise ratio achieved was better than 69 db/MHz in a 2000 MHz band centered on the carrier. High circuit efficiency of 97% and a sharp knee on voltage current characteristic were achieved. The basic problem of maintaining good transfer of heat to the external radiator while providing for adequate connections to input and output was solved. Maximum efficiency achieved was 70.5% and gain and power level were below objectives. An investigation of causes of reduced performance indicated the poor field pattern in the cathode anode interaction area of the tube was a major cause.
 B B

N78-31170# Department of Energy, Washington, D C ERDA Materials Coordinating Committee
SURVEY AND ANALYSIS OF SELECTED TOPICS WITHIN THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION'S (ERDA) MATERIALS RESEARCH AND DEVELOPMENT PROGRAMS
 Jan 1978 137 p
 (Contract W-7405-eng-26)
 (DOI/ET-0006) Avail NTIS HC A07/MF A01

A review of the following is presented: (1) structural alloy development, (2) nondestructive testing, (3) structural ceramics development, (4) general corrosion, (5) erosion and wear, and (6) effects of hydrogen on materials.
 Author (ERA)

N78-31237* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
DEVELOPMENT AND EVALUATION OF ELASTOMERIC MATERIALS FOR GEOTHERMAL APPLICATIONS Annual Report, Oct 1976 - Oct 1977
 W A Mueller, S H Kalfayan, W W Reilly, and J D Ingham
 1 Sep 1978 60 p refs. Prepared for DOE
 (Contract NAS7-100)
 (JPL-Pub-78-69) Avail NTIS HC A04/MF A01 CSCL 11G

A material for a casing packer for service for 24 hours in a geothermal environment was developed by synthesis of new elastomers and formulation of available materials. Formulation included use of commercial elastomer gumstocks and also crosslinking of plastic (high Tg) materials. Fibrous reinforcement of fluorocarbon rubbers was emphasized. Organic fiber reinforcement did not increase hot properties significantly. Glass fiber reinforcement gave significant increase in tensile properties. Elongation was reduced and the glass-reinforced composition examined so far did not hold up well in the geothermal environment. Colloidal asbestos fibers were also investigated. A few experiments with polyphenyl ether gave material with low tensile and high compression set. Available high styrene SBR compositions were studied. Work to date suggests that new synthetic polymers will be required for service in geothermal environments.
 G G

N78-31256# Naval Weapons Center, China Lake, Calif.
ANTIMISTING FUEL SPILLAGE/AIRSHEAR TESTS AT NAVAL WEAPONS CENTER Final Report, Sep 1975 - Dec 1977
 Anthony SanMiguel and Marion D Williams Mar 1978 36 p refs. Original contains color illustrations
 (Contract DOT-FA76WAI-589)
 (AD-A056113, FAA-RD-78-50) Avail NTIS HC A03/MF A01 CSCL 21/2

A test apparatus consisting of a large scale airfoil located within a temperature-velocity-controlled air stream was used to evaluate the fire suppression afforded by FM9 antimisting fuel

additive in Jet A. A homogeneous low turbulence air stream between 100 and 170 knots was used to obtain crash-survivable antimisting fuel kinematic data. It was demonstrated that FM9 could be an effective antimisting agent. The failure envelope for FM9 in 27 C Jet A fuel was measured for agent concentrations from 0.3 to 0.5 percent and 32 C air flow velocities between 100 and 170 knots.
 Author

N78-31257# Naval Weapons Center, China Lake, Calif.
CONVERSION OF TRASH TO GASOLINE Summary Report, 1974 - 1977
 James Diebold and Garyl Smith Apr 1978 26 p refs
 (Contract EPA-1AG-D7-0781)
 (AD-A055113, NWC-TP-6022) Avail NTIS HC A03/MF A01 CSCL 07/1

This report describes a thermochemical process through which organic waste materials found in municipal trash are converted into a high grade gasoline product. The process involves three major steps: selective pyrolysis to form gases relatively rich in olefins such as ethylene, propylene and butylene, compression and purification of the pyrolysis gases to concentrate the olefins and polymerization of the olefins to form polymer gasoline. Pyrolysis experimentation has resulted in about half of the energy in the organic feed being found in the gaseous olefin pyrolysis product. Polymerization of pure ethylene has produced a synthetic crude oil product containing about 90% gasoline having an unleaded motor octane of 90. Preliminary economic evaluation has shown the process to be suitable for relatively small plant sizes. The projected yield of gasoline and oils is about 0.19 l/kg (46 gal/ton). The process is currently in the bench-scale development stage.
 Author (GRA)

N78-31261# Defense Intelligence Agency, Washington, D C
HYDROGEN TECHNOLOGY, FOREIGN
 James D Busi Jun 1978 103 p refs. Supersedes DST-1850S-522-76
 (AD-A055024, DST-1850S-522-78, DST-1850S-522-76) Avail NTIS HC A06/MF A01 CSCL 21/4

Molecular hydrogen has the long-range capability of being a fuel and an efficient energy carrier (a medium for transporting chemical and/or electrical energy), however, hydrogen is not a primary energy source since it is dependent upon other energy sources for its actual production. In general, these dependent energy sources are thermal energy, electrical energy, and radiant energy. Because of hydrogen's specific chemical and physical properties, its more immediate applications are for aviation fuels, industrial chemical production, industrial and domestic heating, off-peak energy storage, electrical and thermal energy transmission, reduction of metal ores, and synthetic food production. Automotive applications employing hydrogen as a fuel are hindered by its poor volumetric energy storage density. The high cost of hydrogen (about \$2.14/GJ (1977 dollars US)) will prevent its use as standard fuel in the near future. Other synthetic fuels derived from advanced coal-gasification processes or fermentation of organic matter for the production of synthetic natural gas (SNG) or alcohols (Methanol and ethanol) presently appear more practical, and are receiving greater foreign and domestic funding. The greatest impact of hydrogen will be on the future international energy policy of the United States. By reducing a country's dependency on imported energy, hydrogen can greatly affect its military capability and socioeconomic stability. The pendulum is presently swinging towards hydrogen acceptance in industrialized countries dependent upon imported energy resources such as Japan, France, West Germany and Italy. Significant hydrogen research programs presently exist in these Western countries.
 GRA

N78-31268# Open Univ., Milton (England). Energy Research Group
THE RELATIVE COSTS OF PRODUCING SYNCRUDE FROM OIL SHALES OF VARIOUS GRADES UNDER VARYING CONDITIONS
 D F Hemming Jan 1978 49 p refs

(ERG-022) Avail NTIS HC A03/MF A01. Secr Energy Res Group, Walton Hall, Milton Keynes Engl

The cost of producing syncrude from oil shales using underground mining and surface retorting and open-pit mining and surface retorting are analyzed. The sensitivity of the calculated cost of production of syncrude to the estimated capital cost of plant and facilities is discussed. The effect on the cost on syncrude production of a labor rate related to the cost of syncrude is also considered. Appendices cover the energy and labor requirements of producing syncrude from oil shales in various ways. ESA

N78-31379# National Technical Information Service, Springfield, Va

MICROWAVE ELECTRIC POWER TRANSMISSION A BIBLIOGRAPHY WITH ABSTRACTS Final Report, 1964 - May 1978

William E. Reed Jun 1978 56 p. Supersedes NTIS/PS-77/0517, NTIS/PS-76/0445 (NTIS/PS-78/0580/7, NTIS/PS-77/0517, NTIS/PS-76/0445) Avail NTIS HC \$28 00/MF \$28 00 CSCL 09C

The citations cover research on the transmission of electric power from one point to another using wireless free space radiated microwave beams. Some of the studies deal with the feasibility of these microwave transmission systems to transmit power from satellite solar power stations. GRA

N78-31385# Battelle Columbus Labs., Ohio STUDY OF HEAT TRANSFER THROUGH REFRACTORY LINED GASIFIER VESSEL WALLS Monthly Technical Progress Report, Jul 1977

J. Richard Schorr Aug 1977 8 p (Contract EX-76-C-01-2210) (FE-2210-18) Avail NTIS HC A02/MF A01

Heat transfer through refractory lined coal gasification vessel walls was evaluated. An empirically derived computer model suitable for determining the heat flow through complex, multicomponent refractory linings, such that the effect of lining thickness, density composition, anchors, gases was developed. The program involves both the development of a heat flow computer model and the experimental measurement of heat flow in a test apparatus. ERA

N78-31394# Battelle Pacific Northwest Labs., Richland, Wash THERMAL PERFORMANCE MEASUREMENTS ON ULTIMATE HEAT SINKS. COOLING PONDS

R. K. Hadlock and O. D. Abbey Feb 1978 105 p refs (Contract EY-76-C-06-1830) (NUREG/CR-0008, PNL-2453) Avail NTIS HC A06/MF A01

Data were collected to characterize thermal performance of heat sinks for nuclear facilities existing at elevated water temperatures in result of experiencing a genuinely large heat load and responding to meteorological influence. The data reflect thermal performance for combinations leading to Worst-case meteorological influence. A geothermal water retention basin was chosen as the site for the measurement program. The data illustrate the thermal and water budgets during episodes of cooling from an initially high pond water bulk temperature. Monitoring proceeded while the pond experienced only meteorological and seepage influence. The data are discussed and are presented as a data volume which may be used for calculation purposes. ERA

N78-31428*# Jet Propulsion Lab., Calif Inst of Tech., Pasadena AUTOMOTIVE TECHNOLOGY STATUS AND PROJECTIONS VOLUME 1 EXECUTIVE SUMMARY

M. Dowdy, A. Burke, H. Schneider, W. Edmiston, G. Klose and R. Heft Jun 1978 51 p refs (Contract NAS7-100) (NASA-CR-157593, JPL-Pub-78-71-Vol-1) Avail NTIS HC A04/MF A01 CSCL 13I

Fuel economy, exhaust emissions, multifuel capability, advanced materials and cost/manufacturability for both conventional and advanced alternative power systems were assessed. To insure valid comparisons of vehicles with alternative power systems, the concept of an Otto-Engine-Equivalent (OEE) vehicle was utilized. Each engine type was sized to provide equivalent vehicle performance. Sensitivity to different performance criteria was evaluated. Fuel economy projections are made for each engine type considering both the legislated emission standards and possible future emissions requirements. A. R. H.

N78-31429*# Jet Propulsion Lab., Calif Inst of Tech., Pasadena AUTOMOTIVE TECHNOLOGY STATUS AND PROJECTIONS VOLUME 2 ASSESSMENT REPORT

M. Dowdy, A. Burke, H. Schneider, W. Edmiston, G. Klose, and R. Heft Jun 1978 414 p refs (Contract NAS7-100) (NASA-CR-157594, JPL-Pub-78-71-Vol-2) Avail NTIS HC A18/MF A01 CSCL 13I

Current and advanced conventional engines, advanced alternative engines, advanced power train components, and other energy conserving automobile modifications which could be implemented by the end of this century are examined. Topics covered include gas turbine engines, Stirling engines, advanced automatic transmissions, alternative fuels, and metal and ceramic technology. Critical problems are examined and areas for future research are indicated. A. R. H.

N78-31436# Teledyne Continental Motors, Muskegon, Mich General Products Div

AUTOMOTIVE DIESEL TECHNOLOGY PROGRAM Final Report, Jun 1975 - Apr 1977

Stephen H. Hill Aug 1977 124 p refs (Contract EY-76-C-03-1099) (SAN-1099-1) Avail NTIS HC A06/MF A01

The preliminary design was finalized for a lightweight automotive diesel that can meet ERDA specification goals. Technology included in the concept design can meet the emission and fuel economy goals of 0.41 HC/3.4 CO/0.4 NO/sub x/ and 25 miles per gallon on the Federal Urban Driving Cycle. The major conclusion reached are that a variable compression ratio swirl chamber diesel with variable injection timing and exhaust gas recirculation can (1) achieve emissions of 0.4 HC/3.4 CO/0.4 NO/sub x/ (2) have fuel economy 55 percent better (MPG) than comparable gasoline engines (3) gave an early introduction into production over present gasoline engine lines (4) have a broad fuel tolerance (unleaded gasoline was run) and (5) be smaller in size and comparable in weight to existing gasoline engines. ERA

N78-31440# Maryland Dept of Transportation, Baltimore THE OUTLOOK FOR AUTOMOTIVE FUEL SUPPLIES, ALTERNATIVE VEHICLE ENGINES, AND POTENTIAL IMPLICATIONS FOR TRANSPORTATION TAX STRUCTURES (1985-2000) Final Report

William Barron, Edwin Crawford, and Morton Weinberg Feb 1978 206 p refs Prepared in cooperation with Johns Hopkins Univ., Baltimore (PB-279679/5, FR-2) Avail NTIS HC A10/MF A01 CSCL 13F

Potential developments in automotive fuel supplies, alternatives to the Otto Cycle engine, and implications of projected developments in these areas for state road user tax arrangements are examined. Alternative heat engines, electric vehicles, and fuel cells are considered in regard to the state of their technological development and ability to utilize nonstandard fuels. Alternative taxing arrangements briefly evaluated are BTU based tax on liquid fuels, increased annual registration fees for alternatively powered vehicles, electric flow recharge metering, tax on traction batteries, periodic odometer readings, and road surface checkpoint metering. GRA

N78-31441# Minicars, Inc., Goleta, Calif
RESEARCH SAFETY VEHICLE PHASE 2, VOLUME 2: COMPREHENSIVE TECHNICAL RESULTS Final Report, Jul. 1975 - Dec. 1976

N DiNapoli, M Fitzpatrick, C Strother, D Struble, and R Tanner
 Nov 1977 809 p

(Contract DOT-HS-5-01215)

(PB-280153/8, DOT-HS-803250-Vol-2) Avail NTIS
 HC A99/MF A01 CSCL 13F

Phase 1 identified trends leading to the desired national social goals of the mid-1980's in vehicle crashworthiness, crash avoidance, damageability, pedestrian safety, fuel economy, emissions and cost, and characterized an RSV to satisfy them. In Phase 2 an RSV prototype was designed, developed, and tested to demonstrate the feasibility of meeting these goals simultaneously. Although further refinement is necessary to assure operational validity, in all categories the results meet or exceed the most advanced performance specified by the presidential task force on motor vehicle goals beyond 1980. GRA

N78-31444# National Bureau of Standards, Washington, D C
 Structures, Materials and Safety Div
SOLAR ENERGY SYSTEMS. STANDARDS FOR RUBBER SEALS Final Report

Robert D Stiehler, Arthur Hockman, Edward J Embree, and Larry W Masters Mar 1978 68 p

(PB-280114/O, NBSIR-77-1437) Avail NTIS
 HC A04/MF A01 CSCL 11A

Thirty preformed and liquid applied seals were evaluated in the laboratory using modified ASTM standard test methods to obtain data needed to prepare the standards. Also, studies were performed to develop a test method for determining the effects of outgassing on the transmittance of solar collector covers. The results of the laboratory tests are presented and standards for rubber seals in solar energy systems are proposed. GRA

N78-31495# Central Treaty Organization Ankara (Turkey)
REGIONAL INVESTIGATIONS OF TECTONIC AND IGNEOUS GEOLOGY, IRAN, PAKISTAN, AND TURKEY Final Report, 1974 - 1978

May 1978 56 p refs Sponsored by NASA. Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls S D 57198 ERTS

(E78-10197, NASA-CR-157387, Rept-28410) Avail NTIS
 HC A04/MF A01 CSCL 08G

The author has identified the following significant results. An extension of the trace of the Chaman-Nushki fault was detected and delineated for 42 km, as was the Ornach-Nal fault for 170 km. Two structural intersections responsible for restricted movements in particular segments of the Chaman-Nushki fault were detected and interpreted. The newest and youngest fault named the Quetta-Mustung-Surab system was delineated for 580 km. The igneous complex of the Lasbela area was interpreted and differentiation was made between ultramafic complex, mafic complex, and basaltic lava flows. One oblong feature was also found which was interpreted as a porphyritic basalt plug.

N78-31506# National Aeronautics and Space Administration, Washington, D C

A SUMMARY OF THE USERS PERSPECTIVE OF LANDSAT-D AND REFERENCE DOCUMENT OF LANDSAT USERS

A Donald Goedeke and Alexander J Tuyahov, Principal Investigator 31 Jan 1977 330 p refs. Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S D 57198 ERTS

(E78-10208, NASA-TM-79744) Avail NTIS
 HC A15/MF A01 CSCL 05B

N78-31511# Jet Propulsion Lab., Calif Inst of Tech., Pasadena
A STUDY OF ALTERATION ASSOCIATED WITH URANIUM OCCURRENCES IN SANDSTONE AND ITS DETECTION BY REMOTE SENSING METHODS, VOLUME 1

James E Conel, M J Abrams, and A F H Goetz 1 Aug 1978 281 p refs Prepared for DOE

(Contract NAS7-100)

(NASA-CR-157600, JPL-Pub-78-86-Vol-1) Avail NTIS
 HC A12/MF A01 CSCL 08G

The anomalous coloration of altered rocks associated with tabular uranium occurrences in the San Raphael Swell, Utah, and remnants of roll-front type deposits in the Powder River Basin, Wyoming was studied. Field and Laboratory spectral reflectance studies on these uranium deposits or occurrences were carried out and supplemented with mineralogical and chemical analyses to determine the origin of spectral features observed. The principal alteration products are goethite/limonite (Utah deposits) and goethite/limonite and hematite (Wyoming deposits). The principal clay mineral present in the deposits is montmorillonite. Statistical analysis of the field data was performed using a stepwise linear discriminant function analysis computer program that determines which combinations of input wavelength bands provide best separation of specified groupings of data. Altered and unaltered rocks could be repeated with 95% accuracy using spectral data including all wavelength bands. Of the satellite-simulated wavelength region tests, LANDSAT D bands gave the best classification accuracy. ARH

N78-31512# Jet Propulsion Lab., Calif Inst of Tech., Pasadena
A STUDY OF ALTERATION ASSOCIATED WITH URANIUM OCCURRENCES IN SANDSTONE AND ITS DETECTION BY REMOTE SENSING METHODS, VOLUME 2

James E Conel, Michael J Abrams, and A F H Goetz 1 Aug 1978 139 p refs Prepared for DOE

(Contract NAS7-100)

(NASA-CR-157601, JPL-Pub-78-86-Vol-2) Avail NTIS
 HC A07/MF A01 CSCL 08G

This document contains tabular and graphic data for volume 1. ARH

N78-31525# National Aeronautics and Space Administration
 Pasadena Office, Calif

SOLAR POND Patent

Charles G Miller (JPL) and James B Stephens, inventors (to NASA) (JPL) Issued 30 May 1978 9 p Filed 30 Jun 1977 Supersedes N77-28584 (15 - 19, p 2550) Continuation of abandoned US Patent Appl SN-590975, filed 27 Jun 1975 sponsored by NASA

(NASA-Case-NPO-13581-2, US-Patent-4,091,800,

US-Patent-Appl-SN-811815, US-Patent-Class-126-271,

US-Patent-Class-237-1A, US-Patent-Appl-SN-590975) Avail
 US Patent Office CSCL 10C

Shallow pools of liquid to collect low-temperature solar generated thermal energy are described. Narrow elongated trenches, grouped together over a wide area, are lined with a heat-absorbing black liner. The heat-absorbing liquid is kept separate from the thermal energy removing fluid by means such as clear polyethylene material. The covering for the pond may be a fluid or solid. If the covering is a fluid, fire fighting foam, continuously generated, or siloons are used to keep the surface covering clean and insulated. If the thermal energy removing fluid is a gas, a fluid insulation layer contained in a flat polyethylene tubing is used to cover the pond. The side of the tube directed towards the sun is treated to block out ultraviolet radiation and trap in infrared radiation.

Official Gazette of the U S Patent Office

N78-31526# National Aeronautics and Space Administration
 Pasadena Office, Calif

NON-TRACKING SOLAR ENERGY COLLECTOR SYSTEM Patent

M Kudret Selcuk, inventor (to NASA) (JPL) Issued 30 May 1978 7 p Filed 3 Feb 1977 Supersedes N77-19579 (15 -

10 p 13358) Sponsored by NASA
(NASA-Case-NPO-13813-1, NASA-Case-NPO-13914-1,
US-Patent-4,091,798, US-Patent-Appl-SN-765139,
US-Patent-Class-126-271 US-Patent-Class-126-270,
US-Patent-Class-350-299) Avail US Patent Office CSCL
10A

A solar energy collector system characterized by an improved concentrator for directing incident rays of solar energy on parallel vacuum-jacketed receivers or absorbers is described. Numerous individually mounted reflector modules of a common asymmetrical triangular cross-sectional configuration are supported for independent reorientation. Asymmetric vee-trough concentrators are defined. Official Gazette of the U.S. Patent Office

N78-31527* National Aeronautics and Space Administration
Pasadena Office, Calif

COAL DESULFURIZATION PROCESS Patent

George C Hsu (JPL), George R Gavalas (JPL), Partha S Ganguli (JPL) and Sarkis H Kalfayan (JPL) Issued 28 Mar 1978 7 p
Sponsored by NASA

(NASA-Case-NPO-13937-1 US-Patent-4 081,250,
US-Patent-Appl-SN-718137 US-Patent-Class-44-1R,
US-Patent-Class-44-2 US-Patent-Class-201-17) Avail US
Patent Office CSCL 07D

A method for chlorinolysis of coal is an organic solvent at a moderate temperature and atmospheric pressure has been proven to be effective in removing sulfur particularly the organic sulfur from coal. Chlorine gas is bubbled through a slurry of moist coal in chlorinated solvent. The chlorinated coal is separated, hydrolyzed and the dechlorinated. Preliminary results of treating a high sulfur (4.77% S) bituminous coal show that up to 70% organic sulfur, 90% hyrcic sulfur and 76% total sulfur can be removed. The treated coal is dechlorinated by heating at 500 C. The presence of moisture helps to remove organic sulfur. Official Gazette of the U.S. Patent Office

N78-31529 Ohio State Univ., Columbus

A VARIABLE INERTIA FLYWHEEL AS AN ENERGY STORAGE SYSTEM Ph D Thesis

David Gordon Ullman 1978 216 p
Avail Univ Microfilms Order No 7812395

A variable inertia flywheel (VIF) system was designed and fabricated to verify theoretical predictions and to evaluate the basic operating characteristics of the concept. A fully controllable VIF, full control over the moment of inertia irrespective of the VIF state, is not practical as the efficiency obtained can be no better than a fixed inertia flywheel with an infinitely variable ratio transmission. However, a VIF with a fixed power recirculation results in a flywheel with a unique torque/angular rate characteristic. A VIF can theoretically be formed such that the torque is related to any function of angular rate. Dissert Abstr

N78-31532* Honeywell, Inc., Minneapolis Minn
SOLAR HEATING AND COOLING SYSTEMS DESIGN AND DEVELOPMENT Quarterly Report, 1 Apr 1977 - 30 Jun 1977

Jul 1977 88 p Prepared for DOE
(Contract NAS8-32093)
(NASA-CR-150770, QR-4) Avail NTIS HC A05/MF A01 CSCL
10A

The development of twelve prototype solar heating/cooling systems, six heating and six heating and cooling systems, two each for single family, multi-family, and commercial applications, is reported. Schedules and technical discussions along with illustrations on the progress made from April 1, 1977 through June 30, 1977 are detailed. G G

N78-31533* National Aeronautics and Space Administration
Lewis Research Center Cleveland Ohio

INITIAL TEST RESULTS WITH A SINGLE-CYLINDER RHOMBIC-DRIVE STIRLING ENGINE Final Report

J E Carrelli, L G Thome and R J Walter Jul 1978 42 p
refs
(Contract EC-77-A-31-1040)

(NASA-TM-78919 E-9656, DOE/NASA/1040-78/1) Avail
NTIS, HC A03/MF A01 CSCL 10B

A 6 kW (8 hp) single-cylinder, rhombic-drive Stirling engine was restored to operating condition and preliminary characterization tests run with hydrogen and helium as the working gases. Initial tests show the engine brake specific fuel consumption (BSFC) with hydrogen working gas to be within the range of BSFC observed by the Army at Fort Belvoir, Virginia in 1966. The minimum system specific fuel consumption (SFC) observed during the initial tests with hydrogen was 669 g/kW hr (1.1 lb/hpx hr), compared with 620 g/kWx hr (1.02 lb/hpx hr) for the Army tests. However, the engine output power for a given mean compression-space pressure was lower than for the Army tests. The observed output power at a working-space pressure of 5 MPa (725 psig) was 3.27 kW (4.39 hp) for the initial tests and 3.80 kW (5.09 hp) for the Army tests. As expected, the engine power with helium was substantially lower than with hydrogen. J M S

N78-31534* National Aeronautics and Space Administration
Lewis Research Center Cleveland Ohio

EFFECT OF INLET TEMPERATURE ON THE PERFORMANCE OF A CATALYTIC REACTOR

David N Anderson 1978 21 p refs Presented at the 3d Workshop on Catalytic Combust Asheville N C 3-4 Oct 1978, sponsored by EPA

(Contract EC-77-A-31-1040)
(NASA-TM-78977, DOE/NASA/1040-78/3 E-9752) Avail
NTIS HC A02/MF A01 CSCL 10A

A 12 cm diameter by 15 cm long catalytic reactor was tested with No. 2 diesel fuel in a combustion test rig at inlet temperatures of 700, 800, 900 and 1000 K. Other test conditions included pressures of 3 and 6 x 10 to the 5th power Pa, reference velocities of 10, 15, and 20 m/s and adiabatic combustion temperatures in the range 1100 to 1400 K. The combustion efficiency was calculated from measurements of carbon monoxide and unburned hydrocarbon emissions. Nitrogen oxide emissions and reactor pressure drop were also measured. At a reference velocity of 10 m/s the CO and unburned hydrocarbons emissions, and, therefore, the combustion efficiency were independent of inlet temperature. At an inlet temperature of 1000 K they were independent of reference velocity. Nitrogen oxide emissions resulted from conversion of the small amount (135 ppm) of fuel-bound nitrogen in the fuel. Up to 90 percent conversion was observed with no apparent effect of any of the test variables. For typical gas turbine operating conditions all three pollutants were below levels which would permit the most stringent proposed automotive emissions standards to be met. Author

N78-31536* CALMAC Mfg Co., Englewood, N J
DESIGN AND INSTALLATION PACKAGE FOR THE SUNMAT FLAT PLATE SOLAR COLLECTOR

Mar 1978 63 p Prepared for DOE
(Contract NAS8-32253)
(NASA-CR-150741) Avail NTIS HC A04/MF A01 CSCL
10A

The information used in evaluating the design of a liquid flat plate solar collector is reported. Included in this package are subsystem performance specification, installation, operation and maintenance manuals, collector sizing guides, and detailed drawings of the single-glazed collector. G G

N78-31537* Boeing Co., Seattle, Wash
APPLICATIONS OF THERMAL ENERGY STORAGE TO PROCESS HEAT STORAGE AND RECOVERY IN THE PAPER AND PULP INDUSTRY Final Report

J H Carr, P J Hurley (Weyerhaeuser Co.), and P J Martin (SRI Intern Corp.) Sep 1978 245 p refs Sponsored by NASA

(Contract EC-77-C-01-5082)
(NASA-CR-159398 CONS/5082-1) Avail NTIS
HC A11/MF A01 CSCL 10A

The transfer of steam production from fossil fuel boilers to waste fuel boilers in a paper and pulp mill powerhouse was studied. Data from specific mills were analyzed, and various TES concepts evaluated for application in the process steam supply system. Constant pressure and variable pressure steam accumulators were found to be the most attractive storage concepts for this application. Performance analyses based on the operation of a mathematical model of the process steam supply system indicate potential substitution of waste wood fuel for 100,000 bbl oil per year per installation with the accumulator TES system. Based on an industry survey of potential TES application, which requires excess base steaming capability, the results from the individual installation were extrapolated to a near-term (1980's) fossil fuel savings in the paper and pulp industry of 32 x 1, million bbl oil/year. Conceptual designs of mechanical equipment and control systems indicate installed cost estimates of about \$560,000 per installation, indicating an after tax return on investment of over 30 percent. G G

N78-31538* Solar Engineering and Mfg Co., Ft. Lauderdale, Fla
DESIGN DATA BROCHURE: SOLAR HOT WATER SYSTEM
 Jul 1978 21 p Prepared for DOE
 (Contract NAS8-32247)
 (NASA-CR-150699) Avail NTIS HC A02/MF A01 CSCL 10A

A design calculation is detailed for a single-family residence housing a family of four in a nonspecific geographical area. The solar water heater system is designed to provide 80 gallons of 140 F hot water per day. G G

N78-31539* National Aeronautics and Space Administration
 Goddard Space Flight Center, Greenbelt, Md
GREENBELT COMMUNITY PROJECT. SOLAR ENERGY RETROFIT FOR A MULTI-FAMILY DWELLING
 E W Hymowitz, R J Hannemann (Hannemann Eng Serv., Upper Marlboro, Md), L L Millman, and J E Pownell Jun 1978 133 p refs
 (NASA-TM-79612) Avail NTIS HC A07/MF A01 CSCL 10A

A cooperative project was initiated between Goddard Space Flight Center and the nearby community of Greenbelt, Maryland. The purpose was to design, install and operate an experimental solar heating system on a group of four tandem town houses. The system was successfully developed and is operating. A description is given of the design, installation, system operation and performance as well as the important considerations for judging the economic feasibility of solar heating systems. L S

N78-31541* Jet Propulsion Lab., Calif Inst of Tech., Pasadena
JPL ENERGY CONSUMPTION PROGRAM (ECP) DOCUMENTATION: A COMPUTER MODEL SIMULATING HEATING, COOLING AND ENERGY LOADS IN BUILDINGS
 F L Lansing, V W Chai, D Lascau, R Urbanajo, and P Wong
 15 Sep 1978 239 p refs
 (Contract NAS7-100)
 (NASA-CR-157599, JPL-PUB-78-76) Avail NTIS HC A11/MF A01 CSCL 10A

The engineering manual provides a complete companion documentation about the structure of the main program and subroutines: the preparation of input data, the interpretation of output results, access and use of the program, and the detailed description of all the analytic, logical expressions and flow charts used in computations and program structure. A numerical example is provided and solved completely to show the sequence of computations followed. The program is carefully structured to reduce both user's time and costs without sacrificing accuracy. The user would expect a cost of CPU time of approximately \$5.00 per building zone excluding printing costs. The accuracy, on the other hand, measured by deviation of simulated consumption from watt-hour meter readings, was found by many simulation tests not to exceed + or - 10 percent margin. G G

N78-31542# Committee on Science and Technology (U S House)

BRIEFING ON DEPARTMENT OF ENERGY

Washington GPO 1977 36 p Hearing before the Subcomm on the Environment and the Atmosphere of the Comm on Sci and Technol., 95th Congr., 1st Sess. 4 Nov 1977
 (GPO-20-083) Avail Subcomm on the Environment and the Atmosphere

The organization of the Department of Energy is discussed in terms of environmental, safety, and related activities. The functions of the various offices within the structure of Department of Energy are stressed. Other topics discussed include the role that environmental impact plays in awarding contracts and the enforcement of occupational health and safety regulations and environmental protection requirements. J M S

N78-31543# Committee on Science and Technology (U S House)

ENVIRONMENTAL CHALLENGES OF THE PRESIDENT'S ENERGY PLAN IMPLICATIONS FOR RESEARCH AND DEVELOPMENT

Washington GPO 1977 181 p refs Rept for Subcomm on the Environment and the Atmosphere of the Comm on Sci and Technol., 95th Congr., 1st Sess., Oct 1977 Prepared by the Library of Congr., Congressional Res Service
 (GPO-96-834) Avail SOD HC

An overview of perceived environmental concerns and Federal environmental related-energy research and development is given with emphasis on the environmental implications of the President's Energy Plan. An experimental environmental monitoring program is suggested to ensure adequate performance of pollution control techniques. J M S

N78-31545# Optical Coating Lab, Inc. City of Industry, Calif
 Photoelectronics Div

HIGH OUTPUT SOLAR CELL WITH MULTILAYER AR COATING Final Report, Aug 1976 - Aug 1977

Peter Iles Wright-Patterson AFB Ohio AFAPL Nov 1977 84 p refs

(Contract F33615-76-C-2166 AF Proj 682J)
 (AD-A054226, AFAPL-TR-77-71) Avail NTIS HC A05/MF A01 CSCL 10/2

During this contract, high efficiency polished surface uncoated cells were prepared and when AR coated with multilayers achieved AMO cell output in the range 74-80 mW. These cells showed promise for space uses, additional work was identified to make these cells fully compatible with present methods for electrostatically bonding integral covers to cells. Author (GRA)

N78-31546# Army Electronics Technology and Devices Lab., Fort Monmouth N J

ALTERNATE POWER SOURCES SESSION NUCLEAR BATTERY HYBRID CONFIGURATION STUDY

Guido Guazzoni 1978 4 p ref Repr from 27th Ann Proc Power Sources Conf Jun 1976
 (AD-A055182) Avail NTIS HC A02/MF A01 CSCL 10/2

Power source requirements for worldwide military applications include a need for low level power (milliwatts average power) under conditions for unattended extended periods of time. The energy content needed in such applications and the requirement for continuous troublefree operation led to the investigation of the military potential of radioisotope thermoelectric power sources, with specific interest in a hybrid configuration using a sealed nickel-cadmium battery. By using the nuclear particle emission energy of radioactive decay nuclear battery devices have the highest stored energy density of any other power source. However, the power output is low being related to the emission half-life of the isotope. Attainment of inherently good device power regulation requires a relatively long life isotope. Plutonium-238 (Pu-238) an 86 year half-life alpha (short range) emitter, has become available in practical quantities. It offers a very low emission hazard and when properly encapsulated in a sintered oxide fuel form it provides an almost ideal isotopic heat source which is safe to use under all anticipated extremes of heat and shock. Author (GRA)

N78-31547# Colorado State Univ Fort Collins Dept of Mechanical Engineering
THERMAL STRATIFICATION ENHANCEMENT FOR SOLAR ENERGY APPLICATIONS Final Report
 R I Loerke, M K Sharp H N Gari, and R D Haberstroh
 Jul 1977 80 p refs
 (Contract N68305-76-C-0036 ZF57571001)
 (AD-A055918 CEL-CR-78 011) Avail NTIS
 HC A05/MF A01 CSCL 10/3

A study is presented that shows methods to enhance stratification in liquid storage tanks. The report focuses on the development of a passive inlet distributor which minimizes mixing between incoming and stored fluids at unlike temperatures. Theoretical analyses and scale model tests were performed. Computer simulations were used to compare mixed storage with stratified storage in a solar space heating system. Test results showed that in some cases nearly ideal stratification can be obtained, and the computer simulations indicated that the load carrying capability of a solar system may be increased 5-10% through the use of stratified storage. Author (GRA)

N78-31548# Globe-Union, Inc., Milwaukee, Wis
DESIGN AND COST STUDY FOR DEVELOPMENT OF LEAD-ACID BATTERIES SUITABLE FOR ELECTRIC VEHICLE PROPULSION Final Report
 C E Weinlein 1977 126 p
 (Contract W-31-109-eng-38)
 (ANL-K-77-3624-1) Avail NTIS HC A07/MF A01

A design for an improved state-of-the-art (ISOA) battery is proposed. It is believed that this ISOA design is the most efficient design achievable within the constraints of the ISOA battery development program. These constraints include realistic time and financial limitations, and compatibility with existing highspeed production equipment. The ISOA battery is in fact an improved, state-of-the-art lead acid battery for use in an electric vehicle. A durable, light weight polypropylene container and cover complete with single point watering and venting features are incorporated in the ISOA design. A number of materials and process parameters with profound affect on battery performance were chosen after extensive evaluation and cell testing. Development of an advanced lead acid electric vehicle battery involved the evaluation, and application of effective forward concepts in the design of the battery. Many weight-saving designs were incorporated. Significant improvements in active material efficiencies and integrity are required. Author (ERA)

N78-31549# California Univ., Livermore Lawrence Livermore Lab
HIGH PERFORMANCE METAL/AIR FUEL CELLS. PART 1: GENERAL REVIEW
 J F Cooper 15 Aug 1977 27 p refs
 (Contract W-7405-eng-48)
 (UCID-17558-Pt-1) Avail NTIS HC A03/MF A01

Metal/air fuel cells are reviewed in terms of their potential application in electric vehicles. Attention is focused on those metals (light alkali and alkaline earth metals, and aluminum) which, in combination with oxygen, have theoretical energy densities exceeding that of gasoline. Lithium and aluminum yielded 8- and 4 kWh/kg, respectively, in laboratory experimental cells. The slurry Zn/air system achieves 0.85 kWh/kg-Zn in prototype vehicle cells and is reviewed for comparison. The remaining metals appear to be unsuitable for use in aqueous electrolyte fuel cells. The discharge characteristics of lithium, aluminum, and (possibly) calcium/air cells indicate the potential for electric vehicles of the highway performance and minimum range (300 miles) of subcompact automobiles, rapid refueling for unlimited range extension, and the storage in the fuel cell of sufficient metal for ranges in excess of 1000 miles. The energy efficiency of a transportation system using aluminum was estimated using data on the current aluminum production industry. ERA

N78-31550# Sandia Labs., Livermore, Calif
SOLAR CENTRAL RECEIVER POWER PLANTS
 A C Skinrood Sep 1977 21 p refs Presented at Solar

Energy Workshop, Ashkhabad, USSR, Sep 1977
 (Contract EY-76-C-04-0789)
 (SAND-77-8510, Conf-770944-1) Avail NTIS
 HC A02/MF A01

Prototype heliostats, receivers, and storage subsystems were built and tested as a part of the recently completed two year research and development program for solar central receiver system technology. This technology will serve as the basis for the detailed design and construction of a 10-MW pilot plant in Barstow, California, scheduled for operation in 1981. Successful operation could lead to the construction of a demonstration plant in the mid to late 1980s. ERA

N78-31551# Westinghouse Electric Corp Tampa Fla
DESIGN AND COST STUDY OF A NICKEL-IRON OXIDE BATTERY FOR ELECTRIC VEHICLES. VOLUME 2 PUBLIC REPORT Final Report
 R E Vail 23 Aug 1977 73 p
 (Contract W-7405-eng-38)
 (ANL-K-3723-1) Avail NTIS HC A04/MF A01

A nickel iron oxide battery design concept is proposed. Development problems were addressed and the methods of solution, identified. The manufacturing cost of the proposed design is identified for annual production quantities of 1,000, 10,000, and 100,000 25 kWh batteries. Based on the high-volume estimates of material, labor, and capital requirements, a selling price of \$60/kWh was found to be attainable. Battery test requirements were identified which will serve to define the performance characteristics of interest to a potential user. A follow-on R and D program plan was developed which combines significant electrode and cell development with demonstrations of performance and potential costs in the form of prototype hardware. ERA

N78-31552# Oklahoma Univ Norman Office of Research Administration
THERMAL AND KINETIC ANALYSIS OF THE PYROLYSIS OF COALS Final Report
 V V Hathi and C M Sliepcevich Aug 1977 253 p refs
 (EPRI Proj 368-1)
 (EPRI-AF-528) Avail NTIS HC A12/MF A01

The thermal decomposition (pyrolysis) of nine bituminous coals of the United States was investigated in a nitrogen atmosphere. Weight loss and rate of weight loss were measured at various heating rates. The major devolatilization occurred between 300 C and 700 C with the peaks shifting to higher temperatures at faster heating rates. Kinetic parameters for each heating rate were derived from these measurements by means of a model which has been used successfully to describe the pyrolysis of woods and wildland fuels. Energetic effects during pyrolysis were measured directly up to 727 C on a Perkin-Elmer differential scanning calorimeter. The decomposition of bituminous coals is endothermic up to 500 C and exothermic thereafter. The energy of pyrolysis is more exothermic with decreasing heating rates. Quantitative repeatability of these energetic measurements was less than desired because of baseline shifts arising from condensation of decomposition products on the surfaces of the sample holder. ERA

N78-31553# Los Alamos Scientific Lab., N Mex
HOT DRY ROCK, AN ALTERNATE GEOTHERMAL ENERGY RESOURCE A CHALLENGE FOR INSTRUMENTATION
 B R Dennis and E H Horton 1978 14 p refs Presented at 24th Intern Instrumentation Symp., Albuquerque, N Mex 1 May 1978
 (Contract W-7405-eng-36)
 (LA-UR-78-707 Conf 780503-8) Avail NTIS
 HC A02/MF A01

The hot dry rock that composes most of the earth's crust has the potential of becoming one of the largest reservoirs of energy economically available in the near future. A technique to demonstrate the technical and economic feasibility of extracting heat from the hot dry rock source is reported that depends upon the connection of two deep boreholes drilled into impermeable precambrian granite where the temperature approaches

200 C The boreholes are connected by a system of hydraulic-produced fractures. Cold water flowing down the deeper hole is heated by the hot rock and brought to the surface through the second hole. The hot water is circulated through a closed-loop heat exchanger. For optimum extraction of energy from this man-made geothermal reservoir it is vital that the absolute location of the fractured system be well established. Fracture mapping techniques include an array of downhole instrumentation. ERA

N78-31554# National Academy of Sciences - National Research Council. Washington D C. Ad Hoc Panel on Low-Btu Gasification of Coal.

ASSESSMENT OF LOW- AND INTERMEDIATE-Btu GASIFICATION OF COAL

Dec 1977 114 p refs

(Contract EX-76-C-01-1216)

(FE-1216-4) Avail NTIS HC A06/MF A01

Low- and intermediate-Btu gases made from coal may be used instead of natural gas or oil in electric power generation and industrial plants. Low-Btu gas cannot be stored economically or transmitted over appreciable distances. Production of low-Btu gas from coal may increase energy costs by approximately 200 percent above the cost of the coal. The overall thermal efficiency of the process is estimated to be about 70 to 80 percent based on cold gas purification. The use of intermediate-Btu gas involves fewer problems than the use of low-Btu gas since the heating value of the gas is high enough to reduce flame temperature limitations and feed gas volumes. It is estimated that the use of intermediate-Btu gas would raise fuel costs 200 to 300 percent above the cost of the coal. The thermal efficiency of the process is 65 to 70 percent based on gas purification at temperatures below 120 C. For the equivalent amount of energy, intermediate-Btu gas is estimated to cost 65 to 75 percent of the cost of pipeline gas produced from coal. A number of other conclusions are listed. ERA

N78-31555# Florida Univ., Gainesville. Dept of Environmental Engineering Sciences.

ENERGY ANALYSIS OF MODELS OF THE UNITED STATES Annual Report

Howard T. Odum and John F. Alexander Jr. 15 Oct 1977 449 p refs

(Contract EY-76-S-05-4398)

Avail NTIS HC A19/MF A01

Systems analysis methods are used to develop bases and environment simulation models for energy concepts and trends.

N78-31556# Florida Univ., Gainesville.

ENERGY ANALYSIS OF MODELS OF THE UNITED STATES, NARRATIVE

Howard T. Odum. In its Energy Analysis of Models of the US 15 Oct 1977 p 1-18

Avail NTIS HC A19/MF A01

Energy bases for the United States were investigated by developing models making quantitative evaluations, and using simulations to understand trends. Concept of energy quality, energy spectra and structure of surviving patterns were studied. Net energies and energy quality factors were calculated with several methods and compared for coal, oil shale, water advection, catastrophes, farming inputs, soils, housing, trade and main flows of biosphere. Models were evaluated from the state of Florida showing its basis in renewable and purchased energies. G G

N78-31557# Florida Univ., Gainesville.

ENERGY ANALYSIS OF MODELS OF THE UNITED STATES, A SUMMARY OF PROGRESS

John F. Alexander Jr. In its Energy Analysis of Models of the US 15 Oct 1977 p 19-41

Avail NTIS HC A19/MF A01

Systems analysis was used to evolve aggregated and component models of energy relationships to make quantitative evaluations and simulations and to calculate parameters of interest in public policy. Current progress in the energy analysis of the United States is indicated and the concurrent development of theory on energy flow relationships is outlined. G G

N78-31558# Florida Univ., Gainesville. Dept of Environmental Engineering Sciences.

ENERGY ANALYSIS, ENERGY QUALITY, AND ENVIRONMENT

Howard T. Odum. In its Energy Analysis of Models of the US 15 Oct 1977 p 44-77 refs

(Contract E(40-1)-4398)

Avail NTIS HC A19/MF A01

A language of energy symbol diagrams was used to develop models and organize data for energy systems analysis and synthesis. Energy analyses included calculations of (1) net energy to evaluate primary sources, (2) an energy investment ratio to evaluate secondary sources, (3) energy savings ratios to evaluate energy conservation, (4) energy effectiveness ratios to evaluate competitive consumer roles. G G

N78-31559# Florida Univ., Gainesville.

ENERGY MODELS OF EXCHANGE WITH SIMULATION OF THE ROLE OF EXCHANGE IN SPATIAL ORGANIZATION

Robert Costanza. In its Energy Analysis of Models of the US 15 Oct 1977 p 78-94 refs

Avail NTIS HC A19/MF A01

An energy model of exchange is formulated that shows energy relations to economics. Computer simulations were used to study effects of external energy resources on exchange and the effect on spatial organization of landscapes. G G

N78-31560# Florida Univ., Gainesville.

EFFICIENCY AND INVESTMENT MATCHING OF HIGH QUALITY ENERGY

Michael S. Burnett. In its Energy Analysis of Models of the US 15 Oct 1977 p 95-114 refs

Avail NTIS HC A19/MF A01

Total efficiency is defined as the energy output divided by the sum of the inputs from fossil fuel and natural sources, including embodied energy, all measured in coal equivalents. For a given energy signature or natural energy input, an optimal amount of fossil fuel investment maximize/efficiency. However, maximizing power causes operation at a lower efficiency than the maximum. G G

N78-31561# Florida Univ., Gainesville.

ENERGY DIAGRAMS OF PUBLISHED ENERGY ANALYSIS OF OTHERS

Howard T. Odum, John F. Alexander, Jr., D. P. Swaney, A. McCallister, E. J. Regan Jr., M. S. Burnett, E. Titron, B. Hanley, G. Noyes, and A. Hermann. In its Energy Analysis of Models of the US 15 Oct 1977 p 116-166 refs

Avail NTIS HC A19/MF A01

Energy analyses were compared by preparing a generalized diagram representing all results in a similar way. Numbers for dollars flows, energy flows, and storages were translated into energy circuit language. The developed diagram aggregates flows into externals, feedbacks from the main economy, and output to the main economy. G G

N78-31562# Florida Univ., Gainesville.

A MESO-MODEL OF THE ECONOMY OF THE UNITED STATES FOR COMPARISON OF ECONOMIC AND ENERGETIC ANALYSIS

Robert Costanza, Amy McCallister, and Jesse Boyles. In its Energy Analysis of Models of the US 15 Oct 1977 p 167-173 refs

Avail NTIS HC A19/MF A01

A preliminary aggregated 13 sector model of the U S economy is presented and possible methods for including renewable energies and labor feedbacks in the calculations, as well as the effects of their inclusion on the final results are discussed. An energy circuit diagram of the economy is also presented and utilized to discuss the relationship between these two approaches. G G

N78-31563# Florida Univ , Gainesville

COMPARISON OF ENERGY ANALYSIS OF OIL SHALE

George M Gardner *In its* Energy Analysis of Models of the US 15 Oct 1977 p 174-212 refs

Avail NTIS HC A19/MF A01

Available data and projections on net energy of oil shale were studied. Included is an energy analysis of oil production at a pilot plant near Rifle, Colorado. A review of seven net energy analyses of proposed and projected oil shale operations showed yield ratios claimed from 68 to 198 as compared to 6 for purchase of foreign oil. G G

N78-31564# Florida Univ , Gainesville

ENERGY ANALYSIS AND MODELS OF SOIL FORMATION

Edward J Regan Jr *In its* Energy Analysis of Models of the US 15 Oct 1977 p 213-260 refs

Avail NTIS HC A19/MF A01

Solar energy costs of soil energy storages were evaluated based upon an energy analysis of soil forming factors. Estimates of the calorie value of soil parameters and the rate of soil formation. The rates of soil formation were derived from literature values and a simulation model of soil formation. The results of the above analyses allow the energy storages of soil to be expressed in solar and coal equivalents. G G

N78-31566# Florida Univ , Gainesville

ENERGY-QUALITY CALCULATIONS FOR FRESHWATER CHEMICAL POTENTIAL

Robert Costanza *In its* Energy Analysis of Models of the US 15 Oct 1977 p 287-296 refs

Avail NTIS HC A19/MF A01

The energy quality of fresh water chemical potential is defined as the relative ability of fresh water to do work in the production processes of the earth. The first calculation was based on process analysis in which specific energy process inputs are traced back to a common source. A biosphere approach determined the cost in solar calories of producing fresh water from rain by the ratio of total input of solar calories to the biosphere to the total quantity of rain produced. A third method of calculation was based on economic input-output analysis and yielded an estimate of the total embodied fossil fuel energy in products. A marginal productivity approach evaluated a substance's ability to do work in specific interactions by production functions. G G

N78-31568# Florida Univ , Gainesville

A HISTORIC AND CURRENT ENERGY ANALYSIS OF FLORIDA

Neil Sipe *In its* Energy Analysis of Models of the US 15 Oct 1977 p 313-337 refs

Avail NTIS HC A19/MF A01

Energy circuit models were used to analyze Florida's current energy base as well as three periods of the state's past. These three periods, primitive, colonial, and limited agriculture, were delineated based upon primary energy sources. It is shown that Florida's growth was greatly accelerated due to the effects of war and that the state exports luxury items to the rest of the U S in exchange for fossil fuels. G G

N78-31569# Florida Univ , Gainesville

STATISTICAL TEST OF ENERGY MODELS FOR PREDICTION OF URBAN GROWTH IN FLORIDA

Edward J Regan Jr *In its* Energy Analysis of Models of the US 15 Oct 1977 p 338-369 refs

Avail NTIS HC A19/MF A01

A model of additive energy input to a logistic balance of input and losses provided the best correlation for predicting urban growth based on energy flows. Included were vegetation and urban production processes. The natural energies were shown to enter directly into the soil and urban production processes from the outside. G G

N78-31570# Florida Univ , Gainesville

SOME ASPECTS OF ENERGY USE IN HOUSING

Mark Brown and Larry Arrington *In its* Energy Analysis of Models of the US 15 Oct 1977 p 400-413 refs

Avail NTIS HC A19/MF A01

Energy calculations are reported for a house unshaded in summer and equipped with solar hot water heating. The energy flows represent the energy required to cool the structure as a result of unshaded, exposed roof, and east, south, and west walls and the energy cost of heating hot water with a solar heater, and also for a shaded home equipped with electric hot water heating. The difference between the shaded and unshaded house is the energy cost of maintaining a solar collector on the roof. It is shown that the energy savings for a solar collector in South Florida are 24.1 x 1 million kcal for 10 years. When the difference in the cost of cooling an unshaded house is subtracted from this energy savings, the savings are substantially reduced. G G

N78-31571# Florida Univ , Gainesville

ENERGY ANALYSIS AND MODEL OF INTERMEDIATE AGRICULTURE

Michael S Burnett *In its* Energy Analysis of Models of the US 15 Oct 1977 p 414-429 ref

Avail NTIS HC A19/MF A01

An energy analysis of a 160 acre low-energy homestead in Arkansas was performed. Low quality solar-driven natural energies were upgraded via the farm system to high quality meat products, which were exchanged for goods and services necessary to maintain the durable technology of the system. Animals grazing on natural improved pasture were the focal point of the energy flows. Wood use for heating, a large garden providing vegetables and fruit for fresh consumption and storage, and several small grain patches were considered important energy conservative habits. Results shown that fossil fuel energy requirements of this family are 15 percent of the American average. G G

N78-31572# Florida Univ , Gainesville

ENERGY ANALYSIS OF BRAZIL

Howard T Odum *In its* Energy Analysis of Models of the US 15 Oct 1977 p 430-440 refs

Avail NTIS HC A19/MF A01

An energy model for the accelerated growth of the Brazilian economy is reported that utilizes statistical data to evaluate overall flows of money and energy in relation to coal equivalents. A summarizing diagram shows that high quality energies of the urban development are made up of hydroelectric power and a free input of renewable resources of the sun because of the large geographic area. The renewable sunlight with its auxiliary energy of the land, soil, rain, and wind contributes six times as much energy in coal equivalents as recognized in the statistical summary of other energies. G G

N78-31573# General Atomic Co , San Diego, Calif

QUALITY ASSURANCE PROGRAM DOCUMENT FOR 75 mW RADIOISOTOPE THERMOELECTRIC GENERATOR PROGRAM

B M Gregory Sep 1977 16 p
(Contract EY-76-C-03-0167-060, Proj 3246)
(GA-A-14807) Avail NTIS HC A02/MF A01

The specifications for the design, fabrication assembly, testing, and delivery of the 75-mW electrical thermoelectric generators

test units in accordance with the contractual requirements are given. The operating agreements and relationships between GA and other participants on quality assurance matters on the program are described. The equipment and activities subject to the quality assurance program and GA's scope of supply and documentation requirements for retention and delivery to the customer are identified. The customer may refer to this document in signifying approval of the quality assurance program what will be implemented by GA for the items within the scope of supply.

ERA

N78-31574# Honeywell, Inc., Minneapolis, Minn Energy Resources Center

SOLAR PILOT PLANT, PHASE 1 PRELIMINARY DESIGN REPORT VOLUME 7 PILOT PLANT COST, COMMERCIAL PLANT COST AND PERFORMANCE, CDRL ITEM 2

1 Jun 1977 140 p refs

(Contract EY-76-C-03-1109)

(SAN-1109-8/9-Vol-7) Avail NTIS HC A07/MF A01

Cost estimates are presented for the Solar Pilot Plant by cost breakdown structure element, with a commitment schedule and an expenditure schedule. Cost estimates are given for a commercial plant, including several point costs for plants with various solar multiples and storage times. Specific questions pertaining to commercial plant design and performance data are addressed. The cost estimates are supplemented by two books of vendor and subcontractor cost data.

ERA

N78-31575# HOLT/PROCON, Pasadena, Calif

PRELIMINARY DESIGN MANUAL FOR A GEOTHERMAL DEMONSTRATION PLANT AT HERBER, CALIFORNIA

B Holt and E L Ghormley Feb 1978 149 p

(EPRI Proj 580)

(EPRI-ER-670) Avail NTIS HC A07/MF A01

A site description, design basis process design, trade-off studies to optimize plant operations, and an economic analysis of the plant are presented. The plant design provides flow diagrams and equipment specifications for the energy conversion system, the cooling water system, the plant and instrument air system, the flare system, the firewater system, the electrical system, the piping system, instruments and controls, and buildings and structures.

ERA

N78-31576# Drexel Univ Philadelphia, Pa

DOUBLE-EXPOSURE COLLECTOR SYSTEM Technical Progress Report, 30 Sep - 30 Dec 1977

Donald C Larson and F William Savery 14 Feb 1978 21 p

(Grant EG-77-G-04-4089)

(TID-28291) Avail NTIS HC A02/MF A01

A retrofit solar water-heating system was installed in a three-story apartment building at Drexel University. The system employs two conventional collector banks (10 PPG collectors) mounted at the latitude angle for Philadelphia of 40 deg from the horizontal and two double-exposure collectors (DEC's) mounted vertically in mirrored enclosures. The performance of the DEC units relative to conventional collectors has been calculated for both a fixed-mirror and an adjustable-mirror configuration. Instrumentation for testing the DEC units performance has been developed and is presently being installed in the apartment building. Preliminary measurements have been obtained, however, of the useful heat output of the DEC units relative to the PPG collectors; these data were obtained on two clear and cold days in December 1977. On these days the DEC units delivered 5.6 to 9.1 times more heat per panel area than the PPG collectors as the PPG collector efficiency varied from 30.2% to 11.9%.

ERA

N78-31577# Texas Univ at Dallas Richardson Center for Energy Studies

GEOTHERMAL EXPLORATION TECHNIQUES A CASE STUDY Final Report

Jim Combs Feb 1978 71 p refs

(EPRI-ER-680) Avail NTIS HC A04/MF A01

A critical evaluation of geothermal exploration methods and techniques are reviewed and performed. The original intent was to publish the work as a handbook, however the information is

not specific enough for that purpose. A broad general survey of geothermal exploration techniques is reported in combination with one specific case study.

ERA

N78-31578# Utah Univ, Salt Lake City

APPLICATION OF DIRECT CONTACT HEAT EXCHANGERS TO GEOTHERMAL POWER PRODUCTION CYCLES Project Review, 1 Dec 1974 - 31 May 1977

H R Jacobs R F Boehm, and A C Hansen 1977 181 p refs

(Contracts EY-76-S-07-1549, EY-76-S-07-1523)

(IDO-1549-8) Avail NTIS HC A09/MF A01

The development of direct contact heat exchanger power cycles for geothermal applications is reviewed. Results from a large experimental program on heat exchanger development as well as from many analyses of components and cycle performance and economics are given. A number of working fluids and operating conditions have been considered, and no major obstacles for the implementation of the concept were discovered.

ERA

N78-31579# McDonnell Aircraft Co, St Louis, Mo

GIROMILL WIND TUNNEL TEST AND ANALYSIS. VOLUME 1. EXECUTIVE SUMMARY Final Report, Jun. 1976 - Oct. 1977

W A Moran Oct 1977 20 p refs

(Contract EY-76-C-02-2617)

(COO-2617-4/1-Vol-1) Avail NTIS HC A02/MF A01

Data from wind tunnel tests are compared with the Larsen cyclogiro vortex theory program employed for predicting the Giromill performance. The Giromill model had a rotor diameter of 7 ft (2.13 meters) and a solidity (total blade area divided by rotor span times diameter) of 0.3. This was achieved by a three bladed rotor having blade chords of 8.4 in (21.3 cm) and a span of 5 ft (1.52 meters). The blades were modulated by use of replaceable cams, that simulated the various operating conditions, and a push rod arrangement connected to a bellcrank about the blade pivot point. Rotor RPM control was achieved with an electric motor/generator that could be used to either drive the rotor or absorb the rotor power to maintain RPM.

N78-31580# Sandia Labs, Albuquerque, N Mex

PERFORMANCE EVALUATION OF WIND ENERGY CONVERSION SYSTEMS USING THE METHOD OF BINS. CURRENT STATUS

R E Akins Mar 1978 21 p refs

(Contract EY-76-C-04-0789)

(SAND-77-1375) Avail NTIS HC A02/MF A01

A detailed description of the method of bins, a technique of data collection and reduction for field performance evaluation of Wind Energy Conversion Systems (WECS) is provided. The method of bins is a straightforward yet useful approach to the complex problem of relating the response of a WECS to a variable wind field. Examples of typical results obtained using the method of bins are presented. Methods of determining that the measure of performance of a WECS obtained is correct are outlined. Areas in which further modifications to the technique may be appropriate are also discussed.

ERA

N78-31581# Los Alamos Scientific Lab, N Mex

USE OF SUPERCONDUCTIVE TECHNOLOGY FOR ENERGY STORAGE AND POWER TRANSMISSION FOR LARGE POWER SYSTEMS. POWER PARKS

W E Keller 1977 19 p refs Presented at Intern Scientific Forum on an Acceptable Nuclear Energy Future of the World, Coral Gables, 7 Nov 1977

(Contract W-7405-eng-36)

(LA-UR-77-2805, Conf-771130-2)

Avail NTIS

HC A02/MF A01

A general review and technology assessment of superconducting magnets for energy storage and superconducting cables for power transmission are presented. It is concluded that the technology is now available for applying superconductivity in the power industry.

ERA

N78-31582# Monsanto Research Corp., Dayton, Ohio
FORM-STABLE CRYSTALLINE POLYMER PELLETS FOR THERMAL ENERGY STORAGE, PHASE 1

R A Botham, G H Jenkins, G L Ball, III, and I O Salyer
 Jul 1977 115 p refs
 (Contract EY-76-C-05-5159)
 (ORO-5159-10) Avail NTIS HC A06/MF A01

TES bed material useful in the 120 to 140 C temperature range suitable for solar absorption air conditioning applications was developed. A Si-O-Si cross-linked HDPE pellet material, demonstrated to have a high heat of fusion value was tested. On melt/freeze cycling of these TES pellets through 400 cycles in ethylene glycol they retained nearly 100% of their initial heat of fusion value, and had excellent form-stability characteristics, with little or no inter-particle adhesion. Testing of this TES pellet material, from analytical to a one gallon lab-scale TES unit and finally to a 60 gallon prototype TES demonstration unit consistently verified these results. C-C crosslinked PE products, which were slightly inferior to the Si-O-Si crosslinked PE in terms of good heat of fusion and form-stability properties, were also developed and are potential alternatives to the prime PE TES product. ERA

N78-31583# Waterloo Univ (Ontario)
CONTINUATION STUDY OF THE POTENTIAL FOR SOLAR HEATING OF BUILDINGS IN CANADA

K G T Hollands and J F Orgill Aug 1977 44 p refs
 (NP-23162) Avail NTIS HC A03/MF A01

WATSUN, a computer program designed to simulate the performance of a solar heating system, was modified. The printed output form was revised to provide more information to the user, and a subroutine was added to model a solar heating system with two liquid storage subsystems. WATSUN was also compared with existing simplified design methods. The program can be used to determine the performance of a specific system for a given location and building. S B S

N78-31584# Open Univ., Milton (England) Energy Research Group

ENERGY ANALYSIS AND OIL SHALE RESERVES

D F Hemming Feb 1978 25 p refs
 (ERG-023) Avail NTIS HC A02/MF A01 Secr., Energy Res Group, Walton Hall, Milton Keynes, Engl

Resources and reserves of shale oil throughout the world are reviewed with the United States having the largest known resources. Locations in the U S of these reserves are noted. An assessment of the ultimate recoverable reserves of oil available from oil shales in the world and in the U S is made with the economically and efficiently recoverable reserves also being given. ESA

N78-31586# National Technical Information Service Springfield, Va

STATE-OF-THE-ART REVIEWS AND BIBLIOGRAPHIES ON ENERGY A BIBLIOGRAPHY WITH ABSTRACTS

Final Report, 1964 - May 1978
 Audrey S Hundemann Jun 1978 219 p Supersedes NTIS/PS-77/0520
 (NTIS/PS-78/0586/4, NTIS/PS-77/0520) Avail NTIS HC \$28 00/MF \$28 00 CSCL 10A

This updated bibliography contains 214 abstracts. Citations to bibliographies, state-of-the-art reviews, and literature surveys on various aspects of fossil fuels, wind, solar energy, hydrogen, geothermal energy, nuclear energy and batteries are presented. A few citations pertain to electric power. GRA

N78-31587# Charles River Associates, Inc., Cambridge, Mass
INTEGRATING POLICY ANALYSIS STUDY MODULE 7 VOLUME 2. TECHNICAL APPENDIX Final Study Module
 William R Hughes 1978 127 p Sponsored by Northwest Energy Policy Project, Portland, Oregon
 (PB-280037/3, NEPP-7-Vol-2) Avail NTIS HC A07/MF A01 CSCL 10A

A demand model and a supply model and an equilibrating

program which ties together the demand and supply models to produce internally consistent forecasts of supply, demand, and prices are described. Tables presenting the results of high, moderate, and low energy forecasts for the Pacific Northwest are included. The methodology used in computing regional benefits and costs is discussed, as is the methodology used to estimate effects of higher energy prices on regional employment income and population. GRA

N78-31588# Utah State Univ., Logan
USE AND ABUSE OF THE REGULATORY PROCESS IN A DEVELOPING SOLAR ENERGY SPACE CONDITIONING INDUSTRY

H Craig Petersen and Bruce M Owen (Stanford Univ.) Dec 1977 60 p refs

(Grant NSF APR-75-18004)

(PB-280165/2, NSF/RA-770457) Avail NTIS HC A04/MF A01 CSCL 05C

Emerging industries providing goods and services in competition with existing regulated industries may find that the regulatory process is used as a weapon against them to prevent their successful entry into the field. Strategic use of regulatory procedures may be as important a competitive tool for regulated industries as are the traditional weapons of price, innovation and product differentiation in unregulated markets. Eight general possibilities for existing regulated firms and potential entrants into an industry to use the regulatory process for their own advantage are suggested. Specific ways in which gas and electric utilities or solar equipment suppliers could use these strategies to alter the rate and nature of development of a solar space conditioning industry are also discussed. GRA

N78-31589# National Standard Reference Data System
PHYSICAL PROPERTIES DATA COMPILATIONS RELEVANT TO ENERGY STORAGE 1. MOLTEN SALTS EUTECTIC DATA

George J Janz, Carolyn B Allen, Joseph R Downey, and R P T Tomkins Mar 1978 252 p refs
 (PB-280795/6, NSRDS-NBS-61-Pt-1, LC-77-10824)
 Copyright Avail NTIS HC A12/MF A01 CSCL 07D

An authoritative compendium of melting points and compositions of molten salt eutectic mixtures is presented. Data for mixtures melting in the range - 138 C to 2800 C are reported. Titles of the articles in the literature citations and a system index are included for approximately 6000 eutectic entries. GRA

N78-31598# Bechtel Corp., San Francisco, Calif
FLUE GAS DESULFURIZATION SYSTEMS DESIGN AND OPERATING CONSIDERATIONS VOLUME 1. EXECUTIVE SUMMARY Final Report, Apr. - Dec 1977

C C Leivo Mar 1978 29 p 2 Vol
 (Contract EPA-68-02-2616)

(PB-280253/6, EPA-600/7-78-030a) Avail NTIS HC A03/MF A01 CSCL 13B

Flue gas desulfurization (FGD) systems and the design and operating parameters that are monitored to ensure proper operation are described. The control of parameters to prevent such problems as scale buildup is included. Effects of designing and operating FGD systems for 90% or greater SO₂ removal efficiencies based on current testing program data, are considered along with effects of coal characteristics on FGD performance. Operating and design techniques used to compensate for coal property variations are discussed. Methods for exhaust gas reheat downstream of FGD systems and alternatives to exhaust gas reheat are discussed. GRA

N78-31599# Bechtel Corp., San Francisco, Calif
FLUE GAS DESULFURIZATION SYSTEMS DESIGN AND OPERATING CONSIDERATIONS VOLUME 2 TECHNICAL REPORT Final Report, Apr. - Dec 1977

C C Leivo Mar 1978 221 p refs 2 Vol
 (Contract EPA-68-02-2616)

(PB-280254/4, EPA-600/7-78-030b) Avail NTIS HC A10/MF A01 CSCL 13B

For abstract, see N78-31598

N78-31606# Research Triangle Inst Durham, N C
**IDENTIFICATION OF COMPONENTS OF ENERGY-RELATED
 WASTES AND EFFLUENTS**

Edo D Pellizari Jan 1978 525 p refs

(Contract EPA-68-03-2368)

(PB-280203/1 EPA-600/7-78-004)

Avail NTIS

HC A22/MF A01 CSCL 07A

A state-of-the-art review on the characterization of organic and elemental substances in energy-related liquid and solid effluents was conducted. Reviewed were data on chemical elements and organic compounds in solid waste and aqueous effluents from (1) coal liquefaction and gasification plants, (2) coal fired power plants, (3) oil shale processors, (4) oil refineries (5) coal mines and (6) geothermal energy. Samples for organic and mercury analysis were subjected to a single analytical protocol in each case to permit comparison among samples. Organic constituents were analyzed by gas chromatography/mass spectrometry/computer and elemental components were determined and measured by spark-source mass spectrometry. GRA

N78-31608# Missouri Water Resources Center, Rolla
**CLEANING COAL WITH COAL: COAL HUMIC ACIDS FOR
 REMOVAL OF ACIDS, ALKALI, SALINITY, AND HEAVY
 METAL POLLUTANTS ASSOCIATED WITH THE USE OF
 COAL AS A FUEL** Final Report

Stanley E Manahan, John B Green, Judith Godwin and Bill Ting 15 Feb 1978 184 p refs

(Contract DI-14-31-0001-4170)

(PB-280580/2, W78-06347 OWRT-8-115-MO(2))

Avail NTIS HC A09/MF A01 CSCL 07A

The use of humic acid (HA) (a constituent of low rank coal) and fly ash (FA) as potential scrubber chemicals for the treatment of water pollution arising from coal combustion effluents is investigated. HA is characterized and purification processes are described. Cation binding by HA is believed to occur via 3 main mechanisms: (1) ortho-phenolic-carboxylic chelation, (2) intra- and intermolecular exchange of acidic groups having appreciable acidity, and (3) exchange following hydrolysis of groups on HA. The mechanism of absorption of SO₂ (a primary constituent of coal combustion effluents) by sodium humates is detailed. Conclusions are an HA-FA system is feasible, HA is effective in dissolving FA, and HA-FA solutions absorb SO₂ well. GRA

N78-31612# Acurex Corp., Mountain View, Calif Energy
 and Environmental Div

**CONTROL TECHNIQUES FOR NITROGEN OXIDES EMIS-
 SIONS FROM STATIONARY SOURCES - SECOND EDITION
 Final Report**

R M Evans, R J Schreiber, H B Mason, W M Toy, and L R Waterland Jan 1978 387 p

(Contract EPA-68-02-2611)

(PB-280034/0 ACUREX/TR-77/87)

Avail NTIS

HC A17/MF A01 CSCL 07A

Information on NO_x emissions covers achievable control levels and alternative methods of prevention and control of NO_x emissions, alternative fuels, processes, and operating methods which reduce NO_x emissions, cost of NO_x control methods, installation, and operation, and the energy requirements and environmental impacts of the NO_x emission control technology. Each stationary source of NO_x emissions was discussed along with the various control techniques and process modifications available to reduce NO_x emissions. Various combinations of equipment process conditions and fuel types are identified and evaluated for NO_x emission control. GRA

N78-31615# Institute of Gas Technology, Chicago, Ill Applied
 Combustion Research

**BURNER DESIGN CRITERIA FOR NO_x CONTROL FROM
 LOW-BTU GAS COMBUSTION. VOLUME 2. ELEVATED
 FUEL TEMPERATURE** Final Report, Oct 1976 - Oct 1977

Donald R Shoffstall and Ricchard T Waibel Dec 1977 87 p
 (Contract EPA-68-02-1360)

(PB-280199/1, EPA-600/7-77-094b)

Avail NTIS

HC A05/MF A01 CSCL 21D

The results of a program to provide quantitative data on combustion emissions from high-temperature low-Btu gas are given. The experimental results were gathered from a pilot-scale furnace fired with a movable-vane boiler burner at a heat input of 0.66 MW (2.25 million Btu/hr). The gases tested in this program--Winkler oxygen, Koppers-Totzek oxygen, and Wellman-Galusha air--ranged from 5.8 MJ/cu m (156 Btu/cu ft) to 9.9 MJ/cu m (266 Btu/cu ft). Measurements were made of NO emissions, temperatures within the flame, and flame emissivity. A mathematical model was used to predict the efficiencies of the furnace with the various fuels; the model agreed well with the experimental measurements. The NO emissions of the gases tested were ordered by the adiabatic flame temperature. GRA

N78-31627 California Univ., Berkeley

**TELLURIC AND D C RESISTIVITY TECHNIQUES APPLIED
 TO THE GEOPHYSICAL INVESTIGATION OF BASIN AND
 RANGE GEOTHERMAL SYSTEMS** Ph D Thesis

John Henry Beyer Jr 1977 475 p

Avail Univ Microfilms Order No 7812493

In recent years considerable interest has developed in the use of geothermal energy. However, much of the exploration technology which exists to find and delineate the features of geothermal systems is in its infancy. Several electrical techniques as applied to geothermal exploration are divided into three independent parts. A natural field electrical exploration technique, the E-field ratio telluric method, is described in Part 1. Two dimensional numerical model study and comparison of the polar dipole-dipole and Schlumberger resistivity arrays is described in Part 2. A detailed interpretation of E-field ratio telluric dipole-dipole resistivity mapping, and dipole-dipole resistivity data obtained in the course of geophysical exploration of the Leach Hot Springs area of Grass Valley, Nevada is discussed in Part 3.

Dissert Abstr

N78-31890# Institute for Energy Analysis, Oak Ridge, Tenn
AN ACCEPTABLE NUCLEAR FISSION FUTURE Summary
 Interim Report

M J Ohanian and A M Weinberg Dec 1977 37 p refs

(ORAU/IEA(M)-77-29) Avail NTIS HC A03/MF A01

The preliminary results of the Institute's examination of the technical and institutional ways of preserving the nuclear option are presented. The main preliminary finding is that nuclear energy ought to be confined to relatively few sites with existing nuclear sites serving as the basis for such a policy. The key elements of a highly collocated system are described with emphasis on strengthened security, professionalism of nuclear personnel, establishment of generating consortia, institutional longevity, and the transition from the LWR-based system to the asymptotic breeder-based system. Brief summaries of the supporting studies in the areas of safety, siting, waste management, legislative and regulatory aspects, and proliferation issues are also included. ERA

N78-31891# General Atomic Co., San Diego, Calif
**ANALYSIS OF NUCLEAR SYSTEMS SATISFYING US
 ENERGY NEEDS**

R F Turner, R H Brogli, D M Ligon, and C J Hamilton Feb 1978 35 p refs

(Contract EY-76-C-03-0167-065)

(GA-A-14848) Avail NTIS HC A03/MF A01

A number of strategies for the development of nuclear power in the U.S. over the next 50 to 60 years were studied systematically. These strategies were evaluated with reference to four vital criteria: (1) limiting the proliferation of nuclear weapon materials, (2) preserving alternatives for assuring a very long term nuclear energy supply to the nation. ERA

N78-31906 Stanford Univ., Calif
AXIAL FIELD LIMITATIONS IN MHD GENERATORS
 Ph.D Thesis

William Charles Unkel, Jr 1978 393 p
 Avail Univ Microfilms Order No 78-14215

The results of an experimental and analytical investigation of axial field breakdown in non-slugging wall, combustion-driven MHD generators are presented. Some experiments and analysis were performed for a segmented Faraday generator, however more detail for a simplified configuration in which a voltage was applied to a pair of adjacent electrodes in the absence of a magnetic field were performed. Significant improvements in generator performance can result from prevention of breakdown is shown. Non-slugging wall generators careful thermal design of the inter-electrode region should alleviate the problem of insulator initiated breakdown is indicated. The results also indicate that for both plasma and insulator initiated breakdown reducing the electrode pitch at fixed average current density to the electrode increases for the resistance of channel to breakdown.

Dissert Abstr

N78-31954* National Aeronautics and Space Administration
 Lewis Research Center, Cleveland, Ohio
OUTLINE OF COST-BENEFIT ANALYSIS AND A CASE STUDY

Abe Kellizy Sep 1978 28 p refs

(NASA-TM-78984, E-9761) Avail NTIS HC A03/MF A01
 CSCL 05C

The methodology of cost-benefit analysis is reviewed and a case study involving solar cell technology is presented. Emphasis is placed on simplifying the technique in order to permit a technical person not trained in economics to undertake a cost-benefit study comparing alternative approaches to a given problem. The role of economic analysis in management decision making is discussed. In simplifying the methodology it was necessary to restrict the scope and applicability of this report. Additional considerations and constraints are outlined. Examples are worked out to demonstrate the principles. A computer program which performs the computational aspects appears in the appendix. LS

N78-31957 Department of Energy, Washington, D C
PRELIMINARY FINDINGS AND VIEWS CONCERNING THE EXEMPTION OF AVIATION GASOLINE FROM THE MANDATORY PETROLEUM ALLOCATION AND PRICE REGULATIONS

Jan 1978 84 p

(DOE/ERA-0001) Avail NTIS HC A05/MF A01

Preliminary findings indicated that the fuel is not in short supply, exemption will not have an adverse impact on supply of any other petroleum product subject to the Emergency Petroleum Allocation Act of 1973, competition and market force are adequate, exemption will not result in inequitable prices, and exemption will not have adverse state or regional impacts or any other adverse impacts. Background information on the use, production, and distribution of aviation gasoline is provided. The historical interaction of supply, demand and price is analyzed. The market structure for aviation gasoline during 1968 to 1976, prior to and during imposition of allocation and price controls is explored. Aviation gasoline supply, demand price, and market structure impacts of exempting aviation gasoline from controls is examined. The potential economic impacts of exemption are evaluated. A final summary of the DOE's findings and views in support of its preliminary judgment that aviation gasoline should be exempted from allocation and price regulations is provided.

ERA

N78-31958 Department of Energy, Washington D C Energy Information Administration
PRELIMINARY FINDINGS AND VIEWS CONCERNING THE EXEMPTION OF KEROJET FUELS FROM THE MANDATORY PETROLEUM ALLOCATION AND PRICE REGULATIONS

Jan 1978 109 p

(DOE/ERA-0002) Avail NTIS HC A06/MF A01

Preliminary findings indicated the following kerojet fuel is not in short supply, it will not adversely impact on the supply of other petroleum products subject to the Emergency Petroleum Allocation Act, competition and market forces are adequate, and it will not result in inequitable prices for kerojet or other products. Background information on the use, production, and distribution of kerojet is provided. The historical interaction of supply, demand, and price is provided. The market structure for kerojet during 1968 to 1976, prior to and during imposition of allocation and price controls is explored. The effect upon kerojet supply, demand, price, and market structure of exempting kerojet from controls is examined. The benefits derived from such exemption is indicated. The potential economic impacts of exemption are evaluated. A final summary of the DOE's findings and views in support of its preliminary judgment that kerojet should be exempted from allocation and price regulations is provided. ERA

N78-32104 Advisory Group for Aerospace Research and Development, Paris (France)

TECHNICAL EVALUATION REPORT ON THE 51ST(B) PEP SPECIALISTS' MEETING OF THE PROPULSION AND ENERGETICS PANEL ON SEAL TECHNOLOGY IN GAS TURBINE ENGINES

B Wrigley (Rolls-Royce Ltd Derby England) Jul 1978 10 p
 refs Meeting held at London 6-7 Apr 1978

(AGARD-AR-123, ISBN-92-835-1289-8) Avail NTIS
 HC A02/MF A01

The following topics are discussed in relation to aircraft and industrial gas turbines: (1) material technology, particularly as applied to main flow path blade tip seals, (2) user's view of seal technology, (3) measurements of seal behavior, (4) laboratory experiments, and (5) design aids. BB

N78-32164* Rockwell International Corp Downey, Calif
 Satellite Systems Div

SATELLITE POWER SYSTEMS (SPS) CONCEPT DEFINITION STUDY: SPS POINT DESIGN DEFINITION UPDATE

G M Hanley 30 Jul 1978 106 p

(Contract NAS8-32475)

(NASA-CR-150690 SD-78-AP-0113) Avail NTIS
 HC A06/MF A01 CSCL 22A

The Rockwell International Photovoltaic Satellite Based Satellite Power System (SPS) Point Design as it is defined through July 1978 is described. The point design to be presented is the result of a series of trade studies. The data established during the period May through July 1978 is incorporated in this summary document. The system relationship of the total Satellite Power System is depicted. This document discusses only the first two elements: the satellite and ground systems. GY

N78-32186* Boeing Commercial Airplane Co., Seattle Wash
ADVANCED COMPOSITES WING STUDY PROGRAM, VOLUME 2 Final Report

Stanley T Harvey and Gary L Michaelson 1 Aug 1978
 119 p 2 Vol

(Contract NAS1-15003)

(NASA-CR-145382-2) Avail NTIS HC A06/MF A01 CSCL
 11D

The study on utilization of advanced composites in commercial aircraft wing structures was conducted as a part of the NASA Aircraft Energy Efficiency Program to establish, by the mid-1980s, the technology for the design of a subsonic commercial transport aircraft leading to a 40% fuel savings. The study objective was to develop a plan to define the effort needed to support a production commitment for the extensive use of composite materials in wings of new generation aircraft that will enter service in the 1985-1990 time period. Identification and analysis of what was needed to meet the above plan requirements resulted in a program plan consisting of three key development areas: (1) technology development, (2) production capability development, and (3) integration and validation by designing, building and testing major development hardware. JAM

N78-32196 California Univ., Berkeley
LEAN LIMIT COMBUSTION IN AN EXPANDING CHAMBER
 Ph.D. Thesis

Owen Irby Smith 1977 140 p
 Avail Univ Microfilms Order No 78-12782

The propagation of methane-air flames in an enclosure designed to simulate conditions encountered in an internal combustion engine was investigated. As the lean flammability limit is approached, the typical automotive engine exhibits an increase in unburned hydrocarbon emissions along with an increase in specific fuel consumption which is characteristic of incomplete combustion. Emphasis was placed on experimental conditions where incomplete combustion in the bulk gas (as opposed to the thermal boundary layer) due to quenching of hydrocarbon oxidation reactions by volume expansion was observed. Cases involving flame propagation in a constant volume chamber, an expanding chamber, and a chamber subjected to a compression-expansion sequence were investigated. The amount of volume expansion is found to be directly related to the occurrence of bulk quenching, while the rate of volume expansion is not.

Dissert Abstr

N78-32276# Army Mobility Equipment Research and Development Center, Fort Belvoir, Va
USE OF THE JET FUEL THERMAL OXIDATION TESTER (JFTOT) FOR PREDICTING DIESEL FUEL PERFORMANCE
 Interim Report

Maurice E LePera and Fred McCaleb Mar 1978 14 p refs
 (AD-A055421 MERADCOM-2235) Avail NTIS
 HC A02/MF A01 CSCL 21/4

An investigation was conducted to define the feasibility for using the Jet Fuel Thermal Oxidation Tester (JFTOT) as a laboratory predictor to assess diesel fuel quality relative to operating performance. A methodology was subsequently established to define diesel fuel performance relative to filter pressure differentials at limiting operating temperatures. A variety of diesel fuels and candidate additives were screened using this approach. The modified JFTOT did effectively screen and discriminate between the fuels as a result of their composition, hydrocarbon quality, and possible contaminants.

Author (GRA)

N78-32282# Energy Research and Development Administration, Washington D C

ALTERNATIVE FUELS DEMONSTRATION PROGRAM
 Final Report

Sep 1977 362 p refs
 (ERDA-1547-Vol-2) Avail NTIS HC A16/MF A01

Alternatives to the proposed demonstration plant program, including environmental trade-off possibilities and a discussion of comments (and the responses) received on the draft environmental statement are given. Five appendices are devoted to synthetic fuel processes, air emission calculations, solid waste calculations, long term scenarios and comment letters.

ERA

N78-32283# Oak Ridge National Lab., Tenn
SYNTHETIC FUELS PROCESS RESEARCH DIGEST

F M OHara Jr and Alan R Spiewak, ed Nov 1977 69 p refs
 (Contract W-7405 eng-26)
 (ORNL/FE-1) Avail NTIS HC A04/MF A01

Coal energy conversion processes are described. They are (1) coal gasification with chemically incorporated catalysts, (2) flash hydrolysis of coal, (3) zinc chloride hydrocracking of coal and coal extracts, and (4) conversion of methanol to high octane gasoline.

LS

N78-32284# Department of Scientific and Industrial Research, Lower Hutt (New Zealand)

METHANOL FROM NATURAL GAS FOR ENGINE FUEL

B T Judd, B V Walker, E E Graham (Canterbury Univ N Zealand), I F Rees (Canterbury Univ N Zealand), and E K Girardin (Canterbury Univ N Zealand) N Zealand Energy Res and Develop Comm Jun 1977 30 p refs

(NP-22771, IR-2 Rept-23) Avail NTIS (US Sales Only)
 HC A03/MF A01, ERDA Depository Libraries

The water tolerance of the methanol/1-octane/benzene system was studied, including the effect on the water tolerance of the presence of selected additives. The conclusion that methanol/gasoline/1-butanol blends can be obtained of adequate stability for commercial distribution is derived. Results show that the use of emulsifying agents to achieve stable blends is not technically possible at the present time. The corrosive effect of methanol on the materials currently used in vehicle fuel systems and in the fuel distribution system is discussed. It is recognized that the introduction of methanol/gasoline blends could create problems in the area of materials compatibility vis-a-vis gasoline and it is recommended that additional work be initiated to provide more detailed information than is presently available. The problem of increased vapor pressure and methods of distribution of methanol/gasoline blends are noted. Results of initial experimental work undertaken with a single cylinder Ricardo engine are described. The need for further extensive work is indicated, however, both with single cylinder and multicylinder engines.

ERA

N78-32285# Brookhaven National Lab Upton N Y
HYDROGEN-TECHNOLOGY EQUIPMENT TEST PROGRAM
 AT BNL

G Strickland, G Beaufriere and A H Rosso 1977 11 p refs
 Presented at DOE Ann Chemical Energy Storage and Hydrogen Energy System Contracts Review Baltimore Md, 16 Nov 1977

(Contract EY-76-C-02-0016)

(BNL-23931, Conf-771131-5) Avail NTIS HC A02/MF A01

In furthering the development of hydrogen energy technology it is essential to test both major and supporting components on a practical scale. The Hydrogen-Technology Advanced-Component Test System (HYTACTS) is being constructed to fulfill this need. Components for production of hydrogen by electrolysis, storage of hydrogen as a metal hydride, and use in several types of energy conversion devices will be tested and evaluated. The first application to be evaluated uses hydrogen as an energy carrier in an electric-energy storage system. Off peak or spinning reserve power is used to electrolyze hydrochloric acid, the hydrogen and chlorine are stored for recombination in the same cell when the demand for power exceeds the system capacity. Hydrogen stored in containers of hydride will also be tested for use as an automotive fuel. The program phases are described along with some details on the equipment to be tested in the hydrogen storage section of the system now being constructed.

ERA

N78-32286# Institute of Gas Technology Chicago, Ill
DEVELOPMENT OF COMBUSTION DATA TO UTILIZE LOW BTU GASES AS INDUSTRIAL PROCESS FUELS Annual Report, 1 Oct 1976 - 30 Sep 1977

Richard T Waibel Jan 1978 40 p
 (Contract EX-76-C-01-2489 Proj 8985)
 (FE-2489-16) Avail NTIS HC A03/MF A01

The combustion data needed to retrofit existing industrial burners to low and medium Btu fuel gases were provided. The pilot-scale furnace was modified to allow the insertion of cooling tubes to provide an adjustable furnace load. This allows the furnace to simulate a variety of industrial processes. A special gas generating system for producing the necessary low and medium-Btu gases was constructed. A Bloom baffle burner, representative of the forward flow type of burner, was installed as the first type of burner to be tested. The cooling tubes were adjusted to simulate the load in the preheat zone of a five-zone steel slab reheat furnace and natural gas baseline data were collected with an input of 5.25 million Btu/hr. The combustion trials included measurements of the thermal efficiency, heat absorption profile, flame shape, flame temperatures, resonance noise level, and flow direction profiles. The thermal efficiencies were 35% for natural gas, 26% for KTO, 23% for WGA, and 22% for WA.

ERA

N78-32287# Mobil Research and Development Corp., Paulsboro, N J Process Research and Technical Service Div
ECONOMIC SCREENING EVALUATION OF UPGRADING COAL LIQUIDS TO TURBINE FUELS Final Report
 M J Dabkowski, R H Heck, A V Perrella, M Schreiner, Jr., and T R Stein Mar 1978 76 p refs Sponsored by Electric Power Research Inst
 (EPRI-AF-710) Avail NTIS HC A05/MF A01

Experimental fixed bed hydroprocessing data were used to estimate costs for a 20 MB/SD hydrotreater including waste water treater and sulfur plant using both utility and equity methods of financing. The costs of upgrading the five coal liquids from the H-Coal and Solvent Refined Coal (SRC) processes vary from \$0.34 to \$2.59/MMBTU of liquid fuel product with utility financing (1976 dollars, 0 percent/year inflation) and \$0.38 to \$2.87/MMBTU with equity financing (1980 dollars 5 percent/year inflation). Cost is a function of the raw coal liquid quality and the hydroprocessing severity necessary to achieve a given product quality. Approximately one-half of the processing cost is for hydrogen input, the other half is about equally divided between capital recovery and operating costs. Capital investment, ranged from \$39 MM to \$273 MM for utility financing (1976 dollars) and \$45 MM to \$308 MM for equity financing (1980 dollars). ERA

N78-32288# Department of Energy Washington, D C Div of Transportation Energy Conservation
PROGRAM PLANNING DOCUMENT HIGHWAY VEHICLE ALTERNATIVE FUELS UTILIZATION PROGRAM (AFUP)
 Apr 1978 96 p refs
 (DOE/CS-0029) Avail NTIS HC A05/MF A01

An alternative automobile fuels research program to assess the feasibility of replacing petroleum as the fuel for highway vehicles in the 1985 to 2000 and beyond time frame is described. Topics discussed include (1) a summary and overview, (2) an analysis of the transportation energy problem and its solution, (3) the justification for a Federal role, (4) technology assessment summary, (5) goals and strategy of the program, and (6) scope of the program. ERA

N78-32289# Oak Ridge National Lab., Tenn Chemistry Div
HYDROGEN PRODUCTION METHODS
 C E Bamberger 1978 13 p refs Presented at the Symp on Energy and Develop in the Americas, Santos, Brazil, 12 Mar 1978
 (Contract W-7405-eng-26)
 (CONF-780325-1) Avail NTIS HC A02/MF A01

Methods presently used and proposed are reviewed. Since it is expected that water will be the only abundant source of hydrogen available in the future the different ways in which water can be decomposed and the possible primary sources of energy that may be used are emphasized. Thermochemical cycles are described in more detail than other methods. Thermochemical cycles consist of several chemical reactions run in a sequence at different temperatures and all the chemicals involved, except water, are regenerated and reused continuously. ERA

N78-32290# Air Products, Inc., Allentown, Pa Corporate Research Dept
CHEMICAL CHARACTERIZATION, HANDLING, AND REFINING OF SOLVENT REFINED COAL TO LIQUID FUELS Final Report
 E N Givens, M A Collura, W Alexander, E J Greskovich, C D Engelman, J B Wetherington, C W Clump (Lehigh Univ., Bethlehem, Pa.), and E K Levy (Lehigh Univ., Bethlehem, Pa.) Sep 1977 297 p refs
 (Contract EY-77-C-01-2003)
 (FE-2003-27) Avail NTIS HC A13/MF A01

Solvent refined coal (SRC) products from the Wilsonville, Alabama and Tacoma, Washington liquefaction facilities were characterized by a broad range of chemical methods. Analytical procedures were established to analyze feed and products from the hydroprocessing of these SRC materials in a unit designed and built specifically for processing residual materials. Authentic and synthetic filtrates were processed upflow in hydrogen over three different commercially available catalysts. Residual (greater

than 850 F boiling point) SRC conversions up to 46 wt percent were observed under typical hydrotreating conditions on authentic filtrate over a cobalt molybdenum catalyst. A synthetic filtrate comprised of creosote oil containing 52 wt percent Tacoma SRC was used for evaluating nickel molybdenum and nickel tungsten catalysts. Nickel molybdenum on alumina catalyst converted more 850 F+ SRC, consumed less hydrogen and produced a better product distribution than nickel tungsten on silica alumina. ERA

N78-32291# Texas Technological Univ., Lubbock
CONVERSION OF CATTLE FEEDLOT MANURE TO ETHYLENE AND AMMONIA SYNTHESIS GAS Final Report
 1 Jan. 1974 - 30 Jun 1977
 William J Huffman, James E Halligan and Roger L Peterson Feb 1978 74 p refs
 (Grant EPA-S-802934)
 (PB-280189/2 EPA-600/2-78-026) Avail NTIS HC A04/MF A01 CSCL 07A

A partial oxidation reactor was scaled-up to evaluate the potential for producing an ammonia synthesis gas from cattle feedlot residue. The synthesis gas from the reactor can be further processed to produce ammonia, using existing commercial technology. A 2.5 meter long, falling-bed reactor was designed, constructed, and operated along with supporting feed and recovery equipment. Manure feed rates to the reactor ranged from 7.7 to 23.6 kilograms per hour. The results show that significant yields of an ammonia synthesis gas and ethylene can be produced in the same reactor when the system is fed with a mixture of air, steam, and manure. GRA

N78-32292# National Technical Information Service, Springfield, Va
HYDROGEN USE AS A FUEL. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1984 - May 1978
 Audrey S Hundemann Jun 1978 167 p Supersedes NTIS/PS-77/0522, NTIS/PS-76/0458
 (NTIS/PS-78/0635/9, NTIS/PS-77/0522, NTIS/PS-76/0458)
 Avail NTIS HC \$28.00/MF \$28.00 CSCL 21D

Federally-funded research studies pertaining to the technical feasibility of using hydrogen as a fuel for vehicular transportation, electric power generation, and both subsonic and supersonic aircraft are discussed. Excluded are studies on hydrogen production and storage. These topics are covered in other bibliographies. This updated bibliography contains 162 abstracts, 29 of which are new entries to the previous edition. GRA

N78-32293# National Technical Information Service, Springfield, Va
NATURAL GAS SUPPLY, DEMAND AND UTILIZATION, VOLUME 2. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1976 - Jun. 1978
 Audrey S Hundemann Jun 1978 259 p Supersedes NTIS/PS-77/0574, NTIS/PS-76/0498
 (NTIS/PS-78/0621/9, NTIS/PS-77/0574, NTIS/PS-76/0498)
 Avail NTIS HC \$28.00/MF \$28.00 CSCL 21D

Abstracts pertaining to natural gas supply and demand, industrial and residential consumption, fuel substitution, availability, costs, Government policies, and regulations are presented. Studies dealing with projections of natural gas use and the economics of supply and demand are included. (This updated bibliography contains 254 abstracts, 90 of which are new entries to the previous edition). GRA

N78-32294# National Technical Information Service, Springfield, Va
HYDROGEN PRODUCTION. A BIBLIOGRAPHY WITH ABSTRACTS Final Report, 1967 - May 1978
 Diane M Cavanaugh Jun 1978 260 p Supersedes NTIS/PS-77/0492, NTIS/PS-76/0459
 (NTIS/PS-78/0514/6, NTIS/PS-77/0492, NTIS/PS-76/0459)
 Avail NTIS HC \$28.00/MF \$28.00 CSCL 21D

A bibliography containing 254 abstracts concerning the manufacturing of hydrogen by electrolysis, coal gasification, and other techniques is presented. Both experimental research and

production on the industrial scale was reviewed. Production methods, as well as economic studies are also included. GRA

N78-32316* Newsom (Bernard D) Los Altos Hills, Calif
RESEARCH PLAN FOR STUDY OF BIOLOGICAL AND ECOLOGICAL EFFECTS OF THE SOLAR POWER SATELLITE TRANSMISSION SYSTEM Final Report

Bernard D Newsom Aug 1978 361 p refs
 (Contract NAS2-9655)

(NASA-CR-3044) Avail NTIS HC A16/MF A01 CSCL 20N

A programmatic research plan for a three year study is presented to generate knowledge on effects of the continuous wave 2.45 GHz microwave power transmission that the Solar Power Satellite might have on biological and ecological elements within and around the rectenna receiving site Author

N78-32359 National Technical Information Service, Springfield Va

ELECTRIC POWER CONSUMPTION, VOLUME 1. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1971 - 1976

Audrey S Hundemann Jun 1978 247 p
 (NTIS/PS-78/0644/1) Avail NTIS HC \$28 00/MF \$28 00 CSCL 10B

A bibliography containing 241 abstracts concerning industrial, commercial, and residential aspects of electric power consumption and demand are presented. Topic areas cover the economics of supply as well as amount of consumption GRA

N78-32360 National Technical Information Service, Springfield, Va

ELECTRIC POWER CONSUMPTION, VOLUME 2. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1977 - Jun 1978

Audrey S Hundemann Jun 1978 127 p Supersedes NTIS/PS-77/0546, NTIS/PS-76/0476, NTIS/PS-75/368 (NTIS/PS-78/0645/8, NTIS/PS-77/0546 NTIS/PS-76/0476, NTIS/PS-75/368) Avail NTIS HC \$28 00/MF \$28 00 CSCL 10B

A bibliography containing 121 abstracts concerning industrial, commercial, and residential aspects of electric power consumption and demand are presented. Topic areas cover the economics of supply as well as amount of consumption GRA

N78-32381 National Technical Information Service, Springfield, Va

ELECTRIC POWER CONSUMPTION CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - Jun. 1978

Audrey S Hundemann Jun 1978 236 p Supersedes NTIS/PS-77/0547 NTIS/PS-76/0477 (NTIS/PS-78/0646/6, NTIS/PS-77/0547, NTIS/PS-76/0477) Avail NTIS HC \$28 00/MF \$28 00 CSCL 10B

Citations from worldwide research on electric power consumption in the commercial, residential, and industrial sectors of the U.S. and many foreign countries are presented. Topic areas cover methods of forecasting electric power demand, computerized load control, and trends in electric power consumption. A few abstracts pertain to the economics of supply and conservation measures GRA

N78-32387* California State Univ., Los Angeles Dept of Mechanical Engineering

DEVELOPMENT OF A DIRECT CONTACT HEAT EXCHANGER, PHASE 1 STUDY REPORT

Ram Manvi 30 Sep 1978 75 p refs
 (Grant NSG-7229)

(NASA-CR-157737, ME-78-NSG-7229) Avail NTIS HC A04/MF A01 CSCL 20D

Electric power generation from geothermal brine requires, first, bringing the hot brine to the surface and then converting the heat to electric power. Binary conversion schemes were proposed, with the heat transfer between the brine and the working organic fluid taking place in a conventional tube and shell heat exchanger. If the brine is heavily laden with dissolved

solids, however, solids buildup on the heat exchanger surfaces leads to a considerable degree of fouling and an accompanying drop in performance is experienced. A possible solution to this problem is the use of a direct contact exchanger with the secondary fluid power cycle. The proposed concept involves the formation of fluid sheets and bells as heat angles. Results of a study concerning the fluid mechanics of such surfaces are given. GG

N78-32426* Jet Propulsion Lab, Calif Inst of Tech, Pasadena
AUTOMOTIVE FUEL ECONOMY AND EMISSIONS PROGRAM Final Report, Jun 1975 - Dec. 1976

Mack W Dowdy and Ronald L Baisley Jun 1978 209 p refs Sponsored in part by NASA

(Contract DOT-RA75-41)

(NASA-CR-157604, JPL-Pub-78 21)

Avail NTIS HC A10/MF A01 CSCL 13I

Experimental data were generated to support an assessment of the relationship between automobile fuel economy and emissions control systems. Tests were made at both the engine and vehicle levels. Detailed investigations were made on cold-start emissions devices, exhaust gas recirculation systems, and air injection reactor systems. Based on the results of engine tests, an alternative emission control system and modified control strategy were implemented and tested in the vehicle. With the same fuel economy and NOx emissions as the stock vehicle, the modified vehicle reduced HC and CO emissions by about 20 percent. By removing the NOx emissions constraint, the modified vehicle demonstrated about 12 percent better fuel economy than the stock vehicle. GG

N78-32443 Department of Energy, Bartlesville, Okla. Energy Research Center

INVESTIGATIVE STUDY OF ENGINE LIMITING

R L Bechtold Feb 1978 19 p refs

(BERC/RI-77/13) Avail NTIS HC A02/MF A01

The effect of cylinder cut-out or engine limiting on fuel consumption and exhaust emissions for a V-type 8-cylinder engine was determined. Increases in energy conversion efficiency while operating with only 4 cylinders ranged from 10 to 40% compared to operation with 8 cylinders at the same power outputs. The speeds and loads chosen were representative of those required to operate a 4500-lb vehicle at speeds up to 60 mph. Hydrocarbon emissions increased at low speed/load points under 4 cylinder operation. An insignificant change in carbon monoxide emissions was observed while an increase in oxides of nitrogen emissions resulted at the higher speed/load points. ERA

N78-32470* Tennessee Eastman Corp., Kingsport
TYPICAL USES OF NASTRAN IN A PETROCHEMICAL INDUSTRY

J Ronald Winter In NASA Marshall Space Flight Center Seventh NASTRAN Users Colloq Oct 1978 p 33-65 (For primary document see N78-32466 23-39)

Avail NTIS HC A21/MF A01 CSCL 20K

NASTRAN was principally used to perform failure analysis, and redesign process equipment. It was also employed in the evaluation of vendor designs and proposed design modifications to existing process equipment. Stress analysis of forced draft fans, distillation trays, metal stacks, jacketed pipes, heat exchangers, large centrifugal fans, and agitator support structures are described. J A M

N78-32520* Geological Survey, University Ala
REMOTE SENSING OF STRIPPABLE COAL RESERVES AND MINE INVENTORY IN PART OF THE WARRIOR COAL FIELD IN ALABAMA Final Report

Thomas J Joiner, Charles W Copeland, Jr., Donald D Russell, Francis E Evans, Jr., C Daniel Sapp, and Peter A Boone Jul 1978 128 p refs

(Contract NAS8-31573)

(NASA-CR-150781) Avail NTIS HC A07/MF A01 CSCL 08G

Methods by which estimates of the remaining reserves of strippable coal in Alabama could be made were developed. Information acquired from NASA's Earth Resources Office was used to analyze and map existing surface mines in a four-quadrangle area in west central Alabama. Using this information and traditional methods for mapping coal reserves, an estimate of remaining strippable reserves was derived. Techniques for the computer analysis of remotely sensed data and other types of available coal data were developed to produce an estimate of strippable coal reserves for a second four-quadrangle area. Both areas lie in the Warrior coal field, the most prolific and active of Alabama's coal fields. They were chosen because of the amount and type of coal mining in the area, their location relative to urban areas, and the amount and availability of base data necessary for this type of study. J M S

N78-32540 State Univ of New York at Binghamton
AN ECONOMETRIC ANALYSIS OF THE ROLE OF AIR AND WATER RESIDUALS IN THE PRODUCTION TECHNOLOGY FOR STEAM-GENERATING ELECTRIC PLANTS
 Ph.D. Thesis

Tran Thi Ngoc Bich 1977 221 p
 Avail Univ Microfilms Order No 78-05543

A production technology model was developed (1) to assess the role of air- and water-borne residuals in the production technology of the plants, (2) to estimate the partial elasticities of substitution between labor and fuel, (3) to test input homotheticity of the production technology (4) to test the hypotheses of separability between the joint outputs (i.e., electricity and residuals emissions) and factor inputs (labor and fuel). Estimates of the role of air- and water-borne emissions in the ex post production technology for the 128 fossil-fuel fired steam-generating plants constructed during the period of 1948 to 1968 in the United States are presented. The overall results strongly support the inclusion of both air- and water-borne residuals measures in estimating the nature of the production technology for fossil-fuel plants for all vintages. Dissert Abstr

N78-32541 Southern Illinois Univ at Carbondale
THE FEASIBILITY OF SOLAR HOUSE HEATING A STUDY IN APPLIED ECONOMICS Ph.D. Thesis

Ali Shams 1977 120 p
 Avail Univ Microfilms Order No 7804312

The performance of a solar heating system for the average single family house in St Louis, Missouri was examined. The optimal mix of solar and conventional forms of heating, taking into account the factors of climate, heat loss coefficient of residential structures, fuel costs, and capital costs associated with solar heating systems of varying sizes was determined. A simulation model was used to measure the annual performance of a solar heating system design of varying capacities. The optimal mix of solar and conventional heat sources was found where the present value of the savings on conventional fuel, taken over the life of the system, is equal to the cost of the system at the margin. The present value of the marginal savings on conventional fuel resulting from the utilization of the solar heating system was compared with the capital cost of the system. Dissert Abstr

N78-32543* Reedy Creek Utilities Co., Inc., Lake Buena Vista Fla

SOLAR HEATING AND COOLING SYSTEM FOR AN OFFICE BUILDING AT REEDY CREEK UTILITIES

Aug 1978 213 p. Sponsored by NASA
 (Contract EX-76-C-01-2401)
 (NASA CR 150748) Avail NTIS HC A10/MF A01 CSCL 10A

The solar energy system installed in a two story office building at a utilities company which provides utility service to Walt Disney World is described. The solar energy system application is 100 percent heating, 80 percent cooling, and 100 percent hot water. The storage medium is water with a capacity of 10,000 gallons hot and 10,000 gallons chilled water. Performance to date has equaled or exceeded design criteria. J M S

N78-32544* Little (Arthur D.), Inc., Cambridge Mass
ASSESSMENT OF INDUSTRIAL APPLICATIONS FOR FUEL CELL COGENERATION SYSTEMS

R P Stickles, J K O'Neill and E H Smith Sep 1978 210 p refs
 (Contract NAS3-20818)
 (NASA-CR-135429, C-81173) Avail NTIS HC A10/MF A01 CSCL 10A

The fuel cell energy systems are designed with and without a utility connection for emergency back-up power. Sale of electricity to the utility during periods of low plant demand is not considered. For each of the three industrial applications, conceptual designs were also developed for conventional utility systems relying on purchased electric power and fossil-fired boilers for steam/hot water. The capital investment for each energy system is estimated. Annual operating costs are also determined for each system. These cost estimates are converted to levelized annual costs by applying appropriate economic factors. The breakeven electricity price that would make fuel cell systems competitive with the conventional systems is plotted as a function of naphtha price. The sensitivity of the breakeven point to capital investment and coal price is also evaluated. Author

N78-32545* Jet Propulsion Lab., Calif Inst of Tech., Pasadena
CHARACTERIZATION OF SOLAR CELLS FOR SPACE APPLICATIONS VOLUME 3 ELECTRICAL CHARACTERISTICS OF OCLI HYBRID MLAR SOLAR CELLS AS A FUNCTION OF INTENSITY AND TEMPERATURE

R G Downing and R S Weiss 1 Sep 1978 39 p refs
 (Contract NAS7-100)
 (NASA-CR-157605, JPL-Pub-78-15-Vol-3) Avail NTIS HC A03/MF A01 CSCL 10A

Electrical characteristics of hybrid multilayer antireflectance coated silicon solar cells are presented in graphical and tabular format as a function of solar illumination intensity and temperature. Author

N78-32546* Honeywell Inc., Minneapolis, Minn Energy Resource Center

SOLAR HEATING AND COOLING SYSTEMS DESIGN AND DEVELOPMENT

Jul 1978 22 p. Prepared for DOE
 (Contract NAS8-32093)
 (NASA-CR-150786) Avail NTIS HC A02/MF A01 CSCL 10A

The development and delivery of prototype solar heating and cooling systems for installation and operational test are detailed. G G

N78-32547* Solafern Ltd., Bourne Mass
INSTALLATION PACKAGE FOR A DOMESTIC SOLAR HEATING AND HOT WATER SYSTEM

Aug 1978 51 p. Prepared for DOE
 (Contract NAS8-32246)
 (NASA-CR-150760) Avail NTIS HC A04/MF A01 CSCL 10A

The installation of two prototype solar heating and hot water systems is described. The systems consists of the following subsystems: solar collector, storage, control, transport, and auxiliary energy. G G

N78-32548* Northrup Inc., Hutchins Tex
INSTALLATION PACKAGE FOR CONCENTRATING SOLAR COLLECTOR PANELS

Aug 1978 55 p. Prepared for DOE
 (Contract NAS8-32251)
 (NASA-CR-150780) Avail NTIS HC A04/MF A01 CSCL 10A

The concentrating solar collector panels comprise a complete package array consisting of collector panels using modified Fresnel prismatic lenses for a 10 to 1 concentrating ratio, supporting framework, fluid manifolding and tracking drive system, and unassembled components for field erection. G G

N78-32549* Colt, Inc of Southern California, Rancho Mirage
PROTOTYPE SOLAR HEATING AND HOT WATER SYSTEMS
 Quarterly Reports, 1 Oct. 1977 - 30 Jun. 1978
 Apr 1978 16 p Prepared for DOE
 (Contract NAS8-32242)
 (NASA-CR-150785) Avail NTIS HC A02/MF A01 CSCL
 10A

Two prototype solar heating and hot water systems are reported that of the following subsystems collector, storage, control, transport, hot water, and auxiliary energy G G

N78-32550* Colt, Inc of Southern California, Rancho Mirage
INSTALLATION PACKAGE FOR A SOLAR HEATING AND HOT WATER SYSTEM
 Aug 1978 76 p Prepared for DOE
 (Contract NAS8-32242)
 (NASA-CR-150757) Avail NTIS HC A05/MF A01 CSCL
 10A

Development and installation of two commercial solar heating and hot water systems are reported. The systems consist of the following subsystems collector, storage, transport, hot water, auxiliary energy and controls. General guidelines are provided which may be utilized in development of detailed installation plans and specifications. In addition, operation, maintenance and repair of a solar heating and hot water system instructions are included G G

N78-32552* Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio Energy Conversion Branch
USAF TERRESTRIAL ENERGY STUDY VOLUME 1: EXECUTIVE SUMMARY Final Report, 1 Apr 1978 - 1 Feb 1978

David C Hall Apr 1978 29 p
 (Contract E(49-28)-1013, AF Proj 3145)
 (AD-A055213, AFAPL-TR-78-19-Vol:1) Avail NTIS
 HC A03/MF A01 CSCL 10/2

Present and future Terrestrial Power (Electrical and Thermal) requirements of the Air Force are summarized and categorized at both base and subbase level, with consideration given to applicable energy conversion technology and potentials

Author (GRA)

N78-32555* Research, Analysis and Development Corp., Colorado Springs, Colo
WASTE ENERGY RECOVERY STUDY Final Report, Apr. - Dec. 1977

Robert A Golobic, Dennis A Mrkvicka, and Harold C Schlicht
 May 1978 212 p refs
 (Contract F08635-77-C-0126)
 (AD-A055452, AFCEC-TR-78-4) Avail NTIS
 HC A10/MF A01 CSCL 13/2

Part 1 of this report outlines the techniques used for determining appropriate schemes for energy recovery. Both thermodynamic and economic considerations are presented. Part 2 contains rejected-energy recovery studies for facilities, which are typical at most installations. Part 3 is primarily concerned with special industrial recovery systems and most examples are a result of the Tinker AFB, OK, survey. Wright-Patterson AFB, OH, was also surveyed during this study. GRA

N78-32556* National Aeronautics and Space Administration
 Marshall Space Flight Center, Huntsville, Ala
FINAL DESIGN REVIEW: MULTI-PURPOSE SENIOR CENTER, SOLAR HEATING AND HOT WATER SYSTEM
 1978 11 p
 (Contract EX-77-A-29-1055)
 (NASA-TM-79754, TID-28140) Avail NTIS
 HC A02/MF A01 CSCL 10A

Discussion at the final design review meeting on the solar heating and hot water system for the multi-purpose Senior Center is presented. Schematics of the system are included. ERA

N78-32557* California Univ., Livermore Lawrence Livermore Lab
GEOTHERMAL RESOURCE DEVELOPMENT: LAWS AND REGULATIONS

James C Wharton 25 Aug 1977 67 p refs
 (Contract W-7405-eng-48)
 (UCRL-52327) Avail NTIS HC A04/MF A01

California state laws on geothermal power production are discussed. Pertinent federal and state provisions are compared and inconsistencies are reported. The question of designating the geothermal resource as a mineral was also reviewed. B B

N78-32558* Oak Ridge Y-12 Plant, Tenn
ECONOMY OF A RETROFIT SOLAR SYSTEM
 J M Schreyer Sep 1977 22 p
 (Contract W-7405-eng-26)
 (Y-2098) Avail NTIS HC A02/MF A01

A privately financed solar augmented hot water system was demonstrated to pay off in less than 10 years if a loan is obtained at 10.5% interest. Calculations were made on the assumption that electricity cost 5 cents per kWh and water consumption averages 30 gallons per day. ERA

N78-32559* Battelle Pacific Northwest Labs., Richland, Wash
SURVEY AND PRELIMINARY EVALUATION OF POTENTIAL GEOTHERMAL ENERGY APPLICATIONS FOR RIVERSIDE, CALIFORNIA

C H Bloomster, L L Fassbender, A H Schilling, and H E Lippek Mar 1978 83 p refs
 (Contract EY-76-C-06-1830)
 (PNL-2597) Avail NTIS HC A05/MF A01

A preliminary assessment of the potential applications for geothermal energy in Riverside, California, was made. The assessment includes both potential electrical and non-electrical applications, and focuses on the following factors: (1) the location of nearby geothermal resources, (2) characteristics of these resources, (3) types of applications suited to each resource, (4) technical and economic feasibility of these applications, (5) the potential impact on the energy demand of each application, and (6) potential deterrents to the utilization of geothermal energy for the most promising application. It is concluded that geothermal energy has a promising potential to supply electricity, space heating and cooling, and process heat to Riverside. ERA

N78-32560* Battelle Pacific Northwest Labs., Richland, Wash
ECONOMIC ANALYSIS OF POTENTIAL USES OF GEOTHERMAL ENERGY IN AGRICULTURE

Bruce W Cone Feb 1978 78 p refs
 (Contract EY-76-C-06-1830)
 (PNL-2568) Avail NTIS HC A05/MF A01

The economic feasibility and water quality considerations of the cultural practice of soil warming was evaluated using existing technical agronomic, and economic data. It was hypothesized that it is technically and economically feasible to use geothermal energy in the cultural practice of soil warming for specific crops. The analysis attempted to reject the hypothesis. Since the hypothesis could not be rejected, the results are presented as a profit equation suitable for inclusion in the GEOCOST computer program. This determination of economic feasibility utilized heterogeneous crop yield data by comparing the elasticity of response with a normalized product-factor price ratio. Soil warming was determined to be feasible when the elasticity of production was equal to or greater than the normalized product-factor price ratio. ERA

N78-32561* Electric Power Research Inst., Palo Alto, Calif
ELECTRIC UTILITY SOLAR ENERGY ACTIVITIES: 1977 SURVEY

L D Cleary Feb 1978 133 p
 (EPRI-ER-649-SR) Avail NTIS HC A07/MF A01

Brief descriptions are given of 458 projects being conducted by 150 utility companies. Also included is a list of participating utilities with information contacts and addresses, a list of utilities with projects designated by category, and a list of utilities organized by state. ERA

N78-32562# Washington Scientific Marketing, Inc., Washington, D C

DEPARTMENT OF ENERGY PROGRAMS AND OBJECTIVES-FLUID WASTE HEAT RECOVERY AND UTILIZATION

Feb 1978 36 p

(Contract W-31-109-eng-38)

(TID-28393) Avail NTIS HC A03/MF A01

The primary objective of the Division of Industrial Energy Conservation is to improve technology that will make industry and agriculture more energy-efficient. Work to remove technological and economic barriers to enhance industrial implementation of energy-efficient processes and technology is reported. Subprograms to carry out the Division's goals are described. These are waste energy reduction, alternate materials utilization, advanced cogeneration-industrial process efficiency, and agricultural and food process efficiency. ERA

N78-32563# Electric Power Research Inst., Palo Alto, Calif
DEMAND 77- EPRI ANNUAL ENERGY FORECASTS AND CONSUMPTION MODEL VOLUME 1- FORECASTS AND GENERAL DESCRIPTION OF THE MODEL

L J Williams, J W Boyd, and R T Crow Mar 1978 77 p refs

(EPRI-EA-621-SR-Vol-1) Avail NTIS HC A05/MF A01

Forecasts of end-use consumption of electricity, petroleum, natural gas and coal for the years 1980 to 2000 are presented. The forecasts are based on an econometric model whose equations represent energy consumption of each form of energy in each end-use sector. The forecasts are based on a forecast of longrun economic growth coupled with three scenarios concerning energy prices and conservation policy. Each of the scenarios was coupled with two scenarios concerning natural gas availability, one in which natural gas is freely available at the assumed price. Forecasts are presented for each of the sectors and for each of the forms of energy by five-year periods. The structure of the econometric model is described along with plans for further development. ERA

N78-32564# Department of Energy, Washington, D C Div of Consumption Data Studies

FEDERAL ENERGY DATA SYSTEM (FEDS). STATISTICAL SUMMARY

Raymond F Fuller Feb 1978 891 p ref

(DOE/EIA-0031/2) Avail NTIS HC A99/MF A01

The Federal Energy Data System (FEDS) has data on annual energy consumption from 1960 through 1975, categorized by fuel sector, and geographic area. The major fuels considered are coal, natural gas, motor gasoline, jet fuel, distillate, residual, electricity and hydro and nuclear power. Data on petrochemical feedstocks, other petroleum products and other raw materials are also included. The sectors considered are residential, commercial, industrial, transportation, and electric utilities. The data are at the State level with census division and national totals included. The FEDS data base also includes selected macroeconomic and demographic data. ERA

N78-32565# Department of Energy, Washington, D C
ENVIRONMENTAL DEVELOPMENT PLAN (EDP). SOLAR HEATING AND COOLING OF BUILDINGS, 1977

Mar 1978 54 p refs

(DOE/EDP-0001) Avail NTIS HC A04/MF A01

The present status and goals of ERDA's solar heating and cooling program are described. Potential environmental, health, safety and socioeconomic impacts of solar technology development and deployment are identified and screened for key issues. A management plan is presented for conducting and coordinating environmental research in concert with technology development to ensure that environmental issues are resolved prior to significant public deployment of the technology. ERA

N78-32566# Electric Power Research Inst., Palo Alto, Calif
Fossil Fuel and Advanced Systems Div

GEOTHERMAL ENERGY PROSPECTS FOR THE NEXT 50 YEARS. PRELIMINARY REPORT TO THE CONSERVATION COMMISSION WORLD ENERGY CONFERENCE

Feb 1978 92 p refs

(EPRI-ER-611-SR) Avail NTIS HC A05/MF A01

Various facets of geothermal energy-resource base electric power potential, and potential nonelectric uses-are considered, using information derived from three sources: (1) analytic computations based on gross geologic and geophysical features of the earth's crust, (2) the literature, and (3) a worldwide questionnaire. Discussion is presented under the following section headings: geothermal resources, electric energy conversion, nonelectric uses, recent international developments, environmental considerations and bibliography. Author (ERA)

N78-32567# Colorado State Univ., Fort Collins Dept of Atmospheric Science

EFFECTS OF ATMOSPHERIC VARIABILITY ON ENERGY UTILIZATION AND CONSERVATION Final Report, 1 Nov. 1976 - 31 Oct. 1977

Elmar R Reiter, E Dreiseltl, G R Johnson, H H Leong, B E MacDonald, W L Somervell, Jr., A M Starr, and K O Timbre Feb 1978 89 p refs

(Contract EY-76-S-02-1340)

(COO-1340-56) Avail NTIS HC A05/MF A01

A space-heating energy-consumption model for Greeley, Colorado for the winter of 1976-77 was within 98.9 percent of actual natural gas consumption for that city. Modeling of Cheyenne, Wyoming, including the testing of a new statistical scheme to develop the building census required by the energy consumption model, has progressed to the point where reliable natural gas consumption estimates can be made with the model for that community. A detailed study of temperature and surface wind patterns in and near the city of Greeley, Colorado revealed that, at times, an urban heat island effect is present, in spite of the relatively small size of that town. Various feedback mechanisms between the oceans and the atmosphere were examined. Several of these mechanisms appear to be the cause of the interannual variability of the atmosphere's general circulation and of climatic changes on a time scale of several tens of years. To advance regional long-range forecasting skills, January temperature anomalies over the eastern United States were correlated with flow patterns over the U.S. and Canada. ERA

N78-32568# California Univ., Berkeley Lawrence Berkeley Lab

ONLY SOURCE OF ENERGY

G J Calvin and M Calvin Mar 1978 15 p

(Contract W-7405-eng-48)

(LBL-7548) Avail NTIS HC A02/MF A01

Various plants that might play a role in the energy mix of the future are discussed and illustrated. Included among them are the Euphorbias and Guayule. ERA

N78-32570# Alaska State Div of Energy and Power Development, Anchorage

MINIMIZING CONSUMPTION OF EXHAUSTIBLE ENERGY RESOURCES THROUGH COMMUNITY PLANNING AND DESIGN Final Report

Oct 1977 149 p refs

(Contract EY-76-C-06-2332)

(RLO-2332-1) Avail NTIS HC A07/MF A01

A study was performed in the State of Alaska and numerous consultants on energy conservation techniques which could be applied to the planning, design, and construction of a new community in the northern climates. This study focused on the minimizing of exhaustible energy resources through planning and design of this new capital city. It was found that the major determinants to energy consumption in a community are the land-use patterns, which affect intracity transportation and utilities distribution, and the built density of the individual homes and buildings which affects heat losses. Configuration of the community also affects the savings that may be realized through the use of district heating and other energy-conserving technologies. ERA

N78-32571# Brookhaven National Lab., Upton, N Y Dept of Nuclear Energy

POTENTIAL NEED FOR FUSION IN THE US ENERGY SYSTEM

E Beardsworth and J Powell Sep 1977 159 p

(Contract EY-76-C-02-0016)

(BNL-50724) Avail NTIS HC A08/MF A01

A study was undertaken to examine how and to what degree fusion might be expected to contribute to U S energy system especially as interpreted through a cost benefit analysis, and as it might bear on current research and development decisions. Conditions under which fusion could contribute significantly to long range U S energy needs was determined. A methodological frame work which sufficiently and appropriately characterizes the U S energy system was developed and key factors that will bear on the need for fusion were identified. B B

N78-32572# California Univ Livermore Lawrence Livermore Lab

ENERGY AND TECHNOLOGY REVIEW

H D Shay, ed, R B Crawford, ed, J K Prono, ed, and J T Staehle, ed Oct 1977 30 p refs

(Contract W-7405-eng-48)

(UCRL-52000-77-10) Avail NTIS HC A03/MF A01

Topics covered include the following: mirror fusion test facility, developing criteria for the management of nuclear wastes, and a dissector-restorer framing tube for recording very fast experiments. ERA

N78-32573# Oak Ridge National Lab., Tenn Energy Div
PERFORMANCE EVALUATION OF A LOW-FIRST-COST, THREE-TON, AIR-TO-AIR HEAT PUMP IN THE HEATING MODE

Albert A Domingorena 1978 40 p ref Presented at the 3d Ann Conf on Heat Pump Technol Stillwater Okla 10-11 Apr 1978

(Contract W-7405-eng-26)

(CONF-780429-1) Avail NTIS HC A03/MF A01

The thermal performance of a three-ton air-to-air heat pump was evaluated in the laboratory under steady-state (no frost) and frosting conditions. In both cases the heating capacity and the coefficient of performance were computed. During frosting conditions, there was a significant decrease in the outdoor airflow rate through the outdoor coil and this resulted in the decrease in the heating capacity and the coefficient of performance. Results indicate the importance of considering the effect of frost accumulation on the outdoor coil. There may be a significant reduction in thermal performance when the outdoor conditions result in substantial formation of frost on the coil and fins of the outdoor unit. Characteristic curves of both fan-motor units indicate that improvement of the efficiency of the units would reduce the operating costs during the life of the heat pump system with a relatively small increase in the fan-motor unit first cost. ERA

N78-32574# Los Alamos Scientific Lab., N Mex
ENERGY SYSTEMS AND STATISTICS Progress Report, Oct. - Dec. 1977

E A Snyder, comp Apr 1978 29 p refs

(Contract W-7405-eng-36)

(LA-7240-PR) Avail NTIS HC A03/MF A01

Work was done to display radiometric data from the Lubbock Quadrangle in pseudocolor plots. Procedures were developed and implemented to split previously sampled areas into 1 deg by 2 deg map sheet areas in support of the Hydrogeochemical and Stream Sediment Reconnaissance Project. Data in the new data base, OIL3, were reviewed and missing and erroneous data entries reported to the Geological Survey. Hardware specifications were developed for a stand-alone/distributed-processing graphics terminal. A method for measuring the sensitivity of an output to a group of inputs taken collectively was implemented in the Transient reactor analysis code. In reviewing documents on the line of assurance approach to reactor safety, the probability model underlying the new approach was analyzed. ERA

N78-32575# Institute for Energy Analysis Oak Ridge, Tenn
ENERGY INTERDEPENDENCE. TODAY AND TOMORROW

J N Barkenbus Apr 1978 35 p refs

(Contract EY-76-C-05-0033)

(ORAU/IEA(O)-78-3) Avail NTIS HC A03/MF A01

The current fossil fuel era, differs substantially from the wood-based energy system. Large institutions are now responsible for satisfying the consumer's energy needs, long distances often separate resource exploitation from resource consumption, and governments now play. The finite nature of fossil fuel resources has created a precarious network of global energy trade and led to serious vulnerabilities within the industrial nations. Future energy systems, based upon nuclear and solar technologies, will make use of fuels which, unlike fossil fuels, are abundant and ubiquitous. An energy future free from the limitations and vulnerabilities associated with the fossil fuel era is envisioned. For numerous reasons, however, utilization of these technologies--over the next half century or so--will require interaction among nations. As a consequence, energy interdependence, rather than national energy independence, is likely to predominate well into the twenty-first century. ERA

N78-32576# Institute for Energy Analysis, Oak Ridge, Tenn
SERVICES AND ENERGY IN U.S. ECONOMIC GROWTH

R W Gilmer Dec 1977 59 p refs

(Contract EY-76-C-05-0033)

(ORAU/IEA(M)-77-33) Avail NTIS HC A04/MF A01

It is often argued that, as economic growth proceeds, service industries will inexorably displace basic manufacturing. If true, and if it is accepted that goods production requires less energy than services, the result will be a decline in energy needs resulting strictly from a secular readjustment of consumption. It was found that such projections are generally over-optimistic, energy savings from structural changes in consumption are probably small in contrast to the kinds of savings that result from policies designed to promote conservation by legal or institutional change or through price incentives. This failure results in part from serious problems concerning productivity and cost escalation in service industries. And it results in part from the dependence of services on sectors using high levels of energy, the total requirements for energy by services, including those requirements they impose on their suppliers, limits the range of potential savings from service-sector growth. Numerical estimates and projections are developed from 1975 to 2000. ERA

N78-32577# Department of Energy, Washington, D C
ENERGY IMPACT ASSISTANCE: REPORT TO THE PRESIDENT

Mar 1978 139 p

(DOE/IR-0009) Avail NTIS HC A07/MF A01

Topics covered include: (1) the nature of the adverse socio-economic impacts from large new energy development projects now occurring and which are likely to occur in the future as domestic resources are developed; (2) the degree to which Federal, state, local, and private programs and efforts are meeting the current needs of communities impacted by energy development and the degree to which they are capable of meeting anticipated needs; and (3) set forth, for the President's decision, possible approaches that might be taken at the Federal level to provide additional assistance to communities that now experience, or may experience in the future, adverse impacts as a result of large new energy developments. The nature of energy development related growth is discussed along with the needs that energy-development-impacted communities are currently experiencing in five areas: public facilities and services, commercial facilities and professional services, housing, social and cultural needs, and transportation. ERA

N78-32578# Argonne National Lab., Ill
COMMUNITY SYSTEMS PROGRAM: ITS GOALS AND ACCOMPLISHMENTS, 1978

Apr 1978 33 p

(Contract W-31-109-eng-38)

(ANL-78-XX-92) Avail NTIS HC A03/MF A01

The Community Systems Program is concerned with conserving energy and scarce fuels through new methods of satisfying the energy needs of American communities. These programs are designed to develop innovative ways of combining current, emerging and advanced technologies into Integrated Community Energy Systems (ICES) that could furnish any, or all, of the energy-using services of a community. The key goals of the Community System Program then, are to identify, evaluate, develop, demonstrate, and deploy energy systems and community designs that will optimally meet the needs of various communities. During 1977, contracts for the following Grid-Connected ICES (G-C ICES) demonstration teams were negotiated: City of Independence, Missouri; Clark University, City of Trenton, New Jersey; Health Education Authority of Louisiana (HEAL); and University of Minnesota. A coal-using ICES, proposed for Georgetown University, also has made noticeable strides toward demonstration of the concept. ERA

N78-32579# Westinghouse Research and Development Center, Pittsburgh, Pa. Research and Development Center
REGIONAL CONCEPTUAL DESIGN AND ANALYSIS STUDIES FOR RESIDENTIAL PHOTOVOLTAIC SYSTEMS Interim Report

P. F. Pittman, E. F. Federmann, R. W. Stoeltzing, W. J. McAllister, P. R. Rittelmann, and S. Nearhoof. Apr 1978. 147 p.
 (Contract EY-76-C-04-0789)
 (SAND-78-7014) Avail NTIS HC A07/MF A01

This preliminary report deals with the methodology of selecting superior on-site photovoltaic total energy residential systems that could apply to most regions of the United States. Selection of sites representing these regions, typical insolation and residential electrical and thermal loads for these sites, and the means of utilizing these data to select the superior systems for each region are reviewed. This entails acquisition of the best available insolation data for the sites selected and analysis of this data to determine a typical year for each site so that hour-by-hour computer analysis can be limited to one year for determination of the lifetime benefit of the system. A further requirement is the determination of electrical and thermal loads for each site so that the match of solar energy converted by the various solar energy systems to the residential load can be made and the solar displacement can be computed. Three levels of screening are used to systematically eliminate those systems which offer less potential than the eventual superior systems. ERA

N78-32580# Department of Energy, Washington, D. C.
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION'S (ERDA) MATERIALS COORDINATING COMMITTEE (EMACC) Annual Report, FY 1977

Feb 1978. 54 p.
 (DOE/ET-0011) Avail NTIS HC A04/MF A01

A set of program summaries from member divisions of the ERDA Materials Coordinating Committee are presented for all divisions except solar energy procurement, Biological and environmental research and environmental control technology. The materials R and D budgets in FY 1977 for the divisions that contributed to the report are summarized. ERA

N78-32581# Los Alamos Scientific Lab., N. Mex.
SOLAR ENERGY RESEARCH AT LASL Progress Report, 1 Jul 1976 - 30 Sep 1977

C. A. Bankston, comp. and D. A. Neeper, comp. Apr 1978. 116 p. refs.
 (Contract W-7405-eng-36)
 (LA-7115-PR) Avail NTIS HC A06/MF A01

The work of the solar energy group (Q-11) during the period July 1976 through September 1977 is reported. The group provided technical support to ERDA, performed research on solar collectors, and carried out systems studies on both active and passive systems. In addition, significant accomplishments occurred in the group's solar air conditioning and mobile/modular solar home projects. ERA

N78-32582# Sandia Labs., Livermore, Calif. Solar Project Div.

ISSUES AND METHODOLOGY FOR THE SELECTION OF A CONCEPTUAL DESIGN FOR A SOLAR CENTRAL RECEIVER PILOT PLANT

A. C. Skinrood. 1978. 14 p. refs. Presented at Symp. on Solar-Thermal Power Stations, Cologne, 12 Apr 1978.
 (Contract EY-76-C-04-0789)
 (SAND-77-8763 Conf-780425-2) Avail NTIS HC A02/MF A01

The selection process developed to recommend a conceptual design for the solar central receiver pilot plant to be built at Barstow, California is described. Included are the key selection issues and their significance. ERA

N78-32583# Department of Energy, Washington, D. C.
REPORT TO THE PRESIDENT AND THE CONGRESS ON THE STATE ENERGY CONSERVATION PROGRAM Annual Report

Dec 1977. 130 p.
 (DOE/CS-0019/1) Avail NTIS HC A07/MF A01

The State Energy Conservation Program was established on December 22, 1975 by the Energy Policy and Conservation Act. The program provided a means by which a State may voluntarily enter into a cooperative effort with the Federal government to further that State's energy conservation efforts. Under the program, each State bore the responsibility for developing and implementing a comprehensive State energy conservation plan. The Federal government, in turn, provided both technical assistance and financial support. Eligibility was extended to all 50 States, the District of Columbia, Puerto Rico, Guam, American Samoa, the Virgin Islands, and the Trust Territory of the Pacific - a total of 56 jurisdictions. Fifty-five of the 56 jurisdictions were participating. The program goal was to reduce the energy consumption within each participating jurisdiction by 5 percent or more annually by 1980. ERA

N78-32584# California Univ., Livermore. Lawrence Livermore Lab.

ENVIRONMENTAL GEOLOGY WORKSHOP FOR THE GEYSERS-CALISTOGA KNOWN GEOTHERMAL RESOURCES AREA

Gene Ledbetter and Neil B. Crow. 8 Feb 1978. 13 p. Workshop held at Sonoma, Calif., 28-29 Nov 1977.
 (Contract W-7405-eng-48)

(UCRL-52418) Avail NTIS HC A02/MF A01

The study included the effects of development on air and water quality, geology, the ecosystem, socioeconomics, and noise. The Geothermal Resource Impact Projection Study (GRIPS) has grants to undertake similar work. On 28 and 29 November 1977, LLL and GRIPS jointly sponsored a workshop at Sonoma State College at which earth scientists presented their views on the potential geological hazards of geothermal development. The workshop produced recommendations for studies in geological mapping, slope stability, subsidence, seismicity, and groundwater hydrology. ERA

N78-32585# National Technical Information Service, Springfield, Va.

ENERGY CONSERVATION INDUSTRY. A BIBLIOGRAPHY WITH ABSTRACTS Final Report, 1964 - May 1978

Audrey S. Hundemann. Jun 1978. 229 p. Supersedes NTIS/PS-77/0505, NTIS/PS-76/0404, NTIS/PS-78/0570/8, NTIS/PS-77/0505, NTIS/PS-76/0404.
 Avail NTIS HC \$28.00/MF \$28.00 CSCL 10A

Potential methods of conserving energy, including fuel and materials substitutions, are considered for various industries. Many abstracts deal with reports that also cover processes used, amount of energy consumed, and environmental considerations of energy conserving options. Industries covered include food, paper, chemical, cement, metals, petroleum refining, contract construction, synthetic rubber, plastic, drug manufacturing, and stone, clay, and glass. Energy conservation through the use of waste heat is covered in a related published search entitled Waste Heat Utilization. GRA

N78-32586# National Technical Information Service, Springfield, Va

ENERGY SUPPLY AND DEMAND MODELING. A BIBLIOGRAPHY WITH ABSTRACTS Final Report, 1964 - May 1978

Audrey S Hundemann Jun 1978 99 p
(NTIS/PS-78/0599/7) Avail NTIS HC \$28 00/MF \$28 00
CSCL 10A

This bibliography contains 94 abstracts. The use of energy models to estimate the supply and demand of electricity, oil, natural gas, coal, and petroleum products on national, regional, and state levels is discussed. The models cover residential, commercial, and industrial supply and demand, the impact of economic conditions on demand, energy use alternatives, and optimal allocation of regionally produced energy resources. Abstracts pertaining to design and development of energy models are included. GRA

N78-32588# Applied Physics Lab Johns Hopkins Univ, Laurel, Md

INVESTMENT IN COMMERCIAL DEVELOPMENT OF OCEAN THERMAL ENERGY CONVERSION (OTEC) PLANT-SHIPS Final Report, Sep. 1976 - Aug. 1977

E J Francis Dec 1977 227 p refs
(Contract MA-5-38054)
(PB-280922/6, APL/JHU/SR-77-3 MA-RD-920-78038) Avail
NTIS HC A11/MF A01 CSCL 07A

The use of ocean thermal energy conversion (OTEC) as an alternative to fossil fuels and nuclear power is discussed. In addition to initial use of OTEC ammonia for production of fertilizers and industrial chemicals, OTEC ammonia can be used as a hydrogen carrier for production of electricity. Economic recommendations and analysis are given. GRA

N78-32589# Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo

INTEGRATED INVENTORIES OF RENEWABLE NATURAL RESOURCES

H Gyde Lund (Bureau of Land Management, Denver), Vernon J Labau, Peter F Ffolliott (Arizona Univ, Tucson), and David W Robinson (Oklahoma State Univ, Stillwater) 1978 493 p refs. Workshop held at Tucson, Ariz, 8-12 Jan 1978, sponsored by Soc of Am Foresters, Arizona Univ, US Forest Service, Dept of Interior, and Renewable Natural Resources Foundation (PB-281036/4, FSGTR/RM-55) Avail NTIS
HC A20/MF A01 CSCL 10A

Efficient, objective and timely inventory systems through integrated inventories are presented in 82 papers. Included are papers covering information requirements, current techniques, need for integrating inventories, land classification systems, remote sensing, principles for integrating inventories, data processing, information systems, and state of the art. GRA

N78-32590# Bureau of Mines, Pittsburgh Pa Eastern Field Operation Center

PROJECTS TO EXPAND FUEL SOURCES IN EASTERN STATES. SURVEY OF PLANNED OR PROPOSED COAL MINES, COAL AND NONCOAL CONVERSION PLANTS, ELECTRIC GENERATING PLANTS, OIL REFINERIES, URANIUM ENRICHMENT FACILITIES, AND RELATED INFRASTRUCTURE, IN STATES EAST OF THE MISSISSIPPI RIVER Final Report, period ending 31 Jul. 1977

David C Benson and Frank J Doyle Aug 1977 153 p
(PB-281249/3 BM-IC-8765) Avail NTIS HC A08/MF A01
CSCL 10A

Tables listing the name, location, and other pertinent data concerning future energy related projects are presented. The tables include information on projects involving the proposed or planned development of fuel resources, as well as the development of storage, transportation and conversion facilities. The report covers the 26 States east of the Mississippi River. Of the total 535 projects for which information is provided, 429 concern coal mines and electric generating plants. GRA

N78-32591# National Technical Information Service, Springfield, Va

FUEL CELLS, VOLUME 2 CITATIONS FROM THE NTIS DATA BASE Progress Report, 1974 - 1978

Diane M Cavagnaro Jul 1978 205 p
(NTIS/PS-78/0632/6) Avail NTIS HC \$28 00/MF \$28 00
CSCL 10B

This bibliography contains 200 abstracts dealing with fuel cell applications, components, fabrication, design, catalysts, and chemistry. Hydrogen oxygen cells, hydrocarbon air cells, and biochemical cells are covered. GRA

N78-32592# National Technical Information Service, Springfield, Va

FUEL CELLS, VOLUME 3. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1977 - Jun. 1978

Diane M Cavagnaro Jun 1978 143 p. Supersedes NTIS/PS-77/0544, NTIS/PS-76/0507 NTIS/PS-75/479, COM-74-11533 (NTIS/PS-78/0633/4, NTIS/PS-77/0544, NTIS/PS-76/0507, NTIS/PS-75/479 COM-74-11533) Avail NTIS
HC \$28 00/MF \$28 00 CSCL 10B

This bibliography contains 138 abstracts. Fuel cell applications, components, fabrication, design, catalysts, and chemistry are covered. Hydrogen oxygen cells, hydrocarbon air cells, and biochemical cells are included. GRA

N78-32593# National Technical Information Service, Springfield, Va

HYDROCARBON FUEL CELLS. CITATIONS FROM THE AMERICAN PETROLEUM INSTITUTE DATA BASE Progress Report, 1967 - Apr 1978

Diane M Cavagnaro Jul 1978 137 p
(NTIS/PS-78/0651/6) Avail NTIS HC \$28 00/MF \$28 00
CSCL 10B

This bibliography presents 126 abstracts on worldwide research on hydrocarbon fuel cells. The citations cover their application, design, performance, fabrication, catalysts, and electrochemistry. GRA

N78-32606# Equitable Environmental, Inc. Park Ridge Ill
ECONOMIC IMPACT OF RELAXING THE REGULATION ON SULFUR CONTENT OF FUEL OILS (R75-8) Final Report

Apr 1978 195 p refs. Sponsored by Illinois Inst for Environmental Quality
(PB-280974/7, IIEQ-77/30) Avail NTIS HC A09/MF A01
CSCL 05C

As a consequence of enacting the proposed regulation, ambient sulfur dioxide levels in Illinois would increase. No violations of the standards would be caused by enacting the proposed regulation. However, several existing violations were recorded in the state. No environmental benefits would result from the proposed regulation. Environmental costs investigated were health, ecological, and materials costs. Enacting the proposed regulation would not, of itself, result in a cost-savings benefit. Rather, fuel oil costs might then vary only as a function of natural market place forces. On the other hand, it seems certain that if the current regulations were maintained, the result would be increases in the cost of both fuel oil and the goods and services of fuel oil users. L S

N78-32609# Illinois Inst for Environmental Quality, Chicago
MORTON GROVE LEAD STUDY. AN INVESTIGATION OF THE CONTRIBUTION OF AIRBORNE LEAD FROM AUTO-MOBILE EXHAUST TO BLOOD LEAD LEVELS IN SUBURBAN CHILDREN Final Report

Sally J Jansen, Bertram W Carnow, and Tsukasa Namekata
Apr 1978 73 p refs
(PB-280717/0, IIEQ-77/13) Avail NTIS HC A04/MF A01
CSCL 06E

Results suggest that airborne lead from autos using heavily traveled roadways may contribute to the blood lead levels of children, especially to that of preschool children. Because of these findings, it is recommended that baffles, such as trees, be utilized along major roadways passing through populated areas. Children residing along such roadways should receive instruction in hygiene so they understand the importance and reason for

keeping non-food items out of their mouths and for frequent and thorough handwashing GRA

**N78-32611# Automotive Testing Labs Inc Aurora, Colo
STUDY OF EXHAUST EMISSIONS FROM 1966 THROUGH
1976 MODEL-YEAR LIGHT-DUTY VEHICLES IN DENVER,
CHICAGO, HOUSTON AND PHOENIX**

Douglas R Liljedahl and Jerry L Terry Aug 1977 803 p
(Contract EPA 68-03 2378)
(PB-280725/3, EPA-460/3-77-005) Avail NTIS
HC A99/MF A01 CSCL 13B

Emission tests were performed on a sample of light-duty vehicles operating in the Chicago, Houston, Phoenix and Denver metropolitan areas. These tests were performed for the determination of light-duty vehicle emission factors. All vehicles were tested in the as-received condition by the Federal Test Procedure. Other tests are included and were also performed under the Federal Test Procedure GRA

**N78-32613# Texas Univ at Austin Dept of Chemical
Engineering.**

**DYNAMICS OF AUTOMOTIVE SULFATE EMISSIONS
Interim Report, Nov 1976 - Nov. 1977**

S H Suck, K DeBower and J R Brock Apr 1978 56 p
refs

(Grant EPA-R-803660)
(PB-280559/6 EPA-600/3-78-043) Avail NTIS
HC A04/MF A01 CSCL 13B

An assessment of the potential environmental impact of automotive sulfonic acid (or sulfate) aerosol was made by analyzing the aerosol dynamics. This analysis lead to a prediction of ambient automotive sulfonic acid aerosol concentrations over and around a large, ten-lane highway with most cars having catalytic converters. The attachment rate of fine automotive sulfonic acid aerosols to ambient aerosols was examined. The dispersion and deposition of automotive sulfate was modelled over the highway for 'worst case' meteorology. The neutralizing effect of ambient ammonia on sulfonic acid concentrations around the highway was examined by a direct simulation procedure for dispersion calculations GRA

**N78-32618# GCA Corp., Bedford, Mass Technology Div
REGULATORY GUIDANCE FOR CONTROL OF VOLATILE
ORGANIC COMPOUND EMISSIONS FROM 15 CATE-
GORIES OF STATIONARY SOURCES Final Report**

Stephen V Capone, Mark I Bornstein, Robert J Brennan, and
William H Battye Apr 1978 209 p refs

(Contract EPA-68-02-2887)
(PB-281138/8, GCA-TR-78-15-G, EPA-905/2-78-001) Avail
NTIS HC A10/MF A01 CSCL 13B

Office of Air Quality Planning and Standards (OAQPS)
Guidance is provided for regulation development in the form of sample regulations based heavily on the guidelines prepared by EPA for 15 categories of stationary sources as well as existing Federal and State laws. In addition a compendium of existing regulations and test procedures is given. The sample regulation are set forth in regulatory format definitions, emission limitations, equipment standards, exemptions, compliance schedules and testing methods and procedures GRA

**N78-32628# Joint Publications Research Service, Arlington,
Va**

**A METHOD OF LOWERING TOXICITY OF EXHAUST FROM
INTERNAL COMBUSTION ENGINES**

Endre Pattantyush-kh /n its Transl on USSR Sci and Technol
Biomedical and Behavioral Sci 8 Aug 1978 p 116-117 refs
Transl into ENGLISH from Gigiyena Sanitarnya (USSR), no 5
1978 p 86-87

Copyright Avail NTIS HC A03/MF A01

The use of ionizing radiation is proposed to lower exhaust toxicity of internal combustion engines that depend on hydrocarbon fuels. Radiochemical reactions break fuel particles down into smaller drops and thus provide for enhanced combustion and lower exhaust gas toxicity G G

**N78-32648# Battelle Pacific Northwest Labs Richland Wash
ESTIMATES OF THE NUMBER OF LARGE AMPLITUDE
GUSTS**

J V Ramsdell Mar 1978 55 p refs

(Contract EY-76-C-06-1830)

(PNL-2508) Avail NTIS HC A04/MF A01

Preliminary estimates for use in the design of wind energy conversion systems are presented. Existing turbulence information was combined with an assumed wind speed distribution to arrive at the estimates. The number of large amplitude gusts per year was treated as a function of the annual mean wind speed and terrain roughness. This treatment is based upon the assumptions that the atmosphere has neutral stability during high winds and that the gustiness is induced by flow over surface roughness elements. Large gusts during thunderstorms and other severe weather phenomena are not treated. The results of the study are presented in tabular form as a function of gust amplitude and hourly average wind speed ERA

**N78-32709# Franklin Inst Research Labs, Philadelphia, Pa
Dept of Science Information Services**

**A LITERATURE REVIEW: PROBLEM DEFINITION STUDIES
ON SELECTED TOXIC CHEMICALS VOLUME 4. OC-
CUPATIONAL HEALTH AND SAFETY ASPECTS OF THE
FOG OILS SGF NO. 1 AND SGF NO. 2 AND SMOKE
SCREENS GENERATED FROM THEM Final Report, Mar.
1977 - Apr 1978**

Deborah Liss-Suter, Jon E Villaume, and Paul N Craig Apr
1978 162 p refs

(Contract DAMB17-77-C-7020, DA Proj 3E7-62720-A-835)
(AD-A055903) Avail NTIS HC A08/MF A01 CSCL 06/20

Literature is reviewed (144 references) on the following subjects: physico-chemical properties, generation of fog oil smoke, human toxicity, occupational hazards and associated health and safety practices and standards, toxicological investigations in animals including mice, rats, guinea pigs, hamsters, monkeys, rabbits, dogs, cats and calves, absorption, distribution, metabolism and excretion in mammals, methods of sampling and determining atmospheric fog oil smoke, and extraction and determination of oils in biologic media. The two fog oils, SGF No 1 and SGF No 2, are both refined petroleum products. SGF No 1 is representative of fuels (similar to fuel oils No 1 and No 2 and light grades of diesel fuel), while SGF No 2 is a lubricating oil (related to light automotive and industrial lubricating oils and mineral oils). The two fog oils have different viscosities, distillation ranges, flash points, and different hydrocarbon compositions, among others. Both oils are used in smoke generators, which vaporize the oils and force the vapors into the atmosphere, where they condense into a dense white smoke screen consisting of oil microdroplets. Effects of continuous exposure of US Army personnel to fog oil smoke screens, for weeks on end, have not been documented GRA

**N78-32868 Stanford Univ Calif
INSULATING WALL BOUNDARY LAYER IN A FARADAY
MHD GENERATOR Ph.D Thesis**

Roy R Rankin 1978 129 p

Avail Univ Microfilms Order No 7814201

The velocity profile at the center of the insulating wall in an MHD generator was measured using a dual beam real time anemometer system with an argon ion laser. The analytic model involved the computer solution, using finite difference techniques of the momentum, energy, and electrical equations including MHD effects for the turbulent insulating wall boundary layer. The turbulence model used was the mixing length theory which was modified to include turbulence damping. Variable, equilibrium properties were employed producing a coupling between the momentum, energy, and electrical equations resulting in extended Hartmann flow. Calculations for a supersonic generator indicate that turbulence damping is unimportant, but that extended Hartmann flow causes a reduction in both the skin friction and the heat transfer and could lead to separation of the insulating wall boundary layer Dissert Abst

N78-32906 Carnegie-Mellon Univ., Pittsburgh, Pa
THE USE OF DISSOCIATING GASES AS THE WORKING FLUID IN THERMODYNAMIC POWER CONVERSION CYCLES Ph.D. Thesis

Krishnamurthy Kesavan 1978 274 p
 Avail Univ Microfilms Order No 7814383

Increasing need for more effective utilization of all available energy sources and for reduction in the capital costs of electrical power generation points to the need for developing systems with higher thermodynamic efficiencies and smaller simpler components. The potential of steam, which is the dominant working fluid in fossil and nuclear power conversion cycles, were fully exploited. The potential of chemically dissociating substances working fluids in achieving smaller and simpler plants with improved cycle performance is explored. Results indicate that the dissociating gases can provide attractive alternatives to conventional steam and inert gases in terms of reduced electric generation costs through improved cycle efficiencies, smaller components and simpler plant arrangements.

Dissert Abstr

N78-32828/ Committee on Science and Technology (U S House)

NASA AUTHORIZATION, 1979, VOLUME 1, PART 3

Washington GPO 1978 2091 p refs Hearings on H R 10664 (superseded by H R. 11401) before Subcomm on Space Sci and Applications of the Comm on Sci and Technol, 95th Congr, 2d Sess, 8-9, 22-23 Feb 1978
 (GPO-25-291) Avail Subcomm on Space Sci and Applications

Testimony given in response to direct questions and statements delivered in support of NASA budget requests are presented. Topics cover NASA OE cooperation in the development of energy technology with emphasis on the satellite solar power satellite program, space shuttle status and applications, satellite communication systems, NASA in-house management matters, and the agency's operating plan.

ARH

N78-33102* National Aeronautics and Space Administration
 Lewis Research Center, Cleveland, Ohio
RESULTS AND STATUS OF THE NASA AIRCRAFT ENGINE EMISSION REDUCTION TECHNOLOGY PROGRAMS

R E Jones, L A Diehl, D A Petrash, and J Grobman Oct 1978 53 p refs
 (NASA-TM-79009, E-9793) Avail NTIS HC A04/MF A01 CSDL 21E

The results of an aircraft engine emission reduction study are reviewed in detail. The capability of combustor concepts to produce significantly lower levels of exhaust emissions than present production combustors was evaluated. The development status of each combustor concept is discussed relative to its potential for implementation in aircraft engines. Also, the ability of these combustor concepts to achieve proposed NME and NCE EPA standards is discussed.

B B

N78-33161 Brigham Young Univ., Provo, Utah
METHANATION CATALYSTS ACTIVITY, ADSORPTION AND DEGRADATION STUDIES OF NICKEL AND NICKEL BIMETALLIC CATALYSTS FOR METHANATION Ph.D. Thesis

Richard Byron Pannell 1978 189 p
 Avail Univ Microfilms Order No 7813813

Adsorption of hydrogen, carbon monoxide, oxygen and hydrogen sulfide catalytic activity for methanation and thermal degradation of nickel and nickel bimetallic catalysts were investigated. The adsorption of hydrogen on nickel powder was shown to be H/Ni = 1. This ratio was also shown to be one on supported nickel catalysts from hydrogen chemisorption. X-ray line broadening and electron microscopy CO adsorption was shown to depend upon pressure, temperature, composition and support. Oxygen adsorption is multilayer in nature and tempera-

ture dependent. Hydrogen sulfide adsorbs dissociatively and fully saturates nickel surfaces above 5 ppm in hydrogen. Activity tests show nickel and cobalt to be very active methanation catalysts. Metal loading and composition alter catalyst activity and product distribution, especially higher hydrocarbons. Adsorbed sulfur also alters activity and product distribution.

Dissert Abstr

N78-33164* National Aeronautics and Space Administration
 Pasadena Office Calif

COAL DESULFURIZATION Patent Application

George C Hsu, inventor (to NASA) (JPL) Filed 16 Feb 1978
 13 p Sponsored by NASA
 (NASA-Case-NPO-14272-1 US-Patent-Appl-SN-878253) Avail NTIS HC A02/MF A01 CSDL 07D

Organic sulfur is removed from coal by treatment with an organic solution of iron pentacarbonyl. Organic sulfur compounds can be removed by reaction of the iron pentacarbonyl with coal to generate CO and COS off-gases. The CO gas separated from COS can be passed over hot iron fillings to generate iron pentacarbonyl.

NASA

N78-33210/ General Electric Co., Schenectady, N Y Energy Systems Programs Dept

HOT CORROSION/EROSION TESTING OF MATERIALS FOR APPLICATIONS FOR ADVANCED POWER CONVERSION SYSTEMS USING COAL-DERIVED FUELS. TASK 2 EVALUATION OF TURBINE MATERIALS FOR USE IN A COAL-FIRED FLUIDIZED BED COMBUSTION ENVIRONMENT Progress Report, Feb. 1978

R L McCarron Mar 1978 21 p
 (Contract EX-76-C-01-2326)
 (FE-2326-20, PR-20) Avail NTIS HC A02/MF A01

Activities are reported in a program to provide 1000-hour engineering data on the corrosion/erosion deterioration of gas turbine materials U 700 and IN-738 exposed to the exhaust gas from a pressurized fluidized bed combustor. The results show that on the leading edges of the specimens there was deposition, corrosion, and erosion all occurring in the same area. It is reasonable to expect that corrosion and erosion might occur simultaneously. The occurrence of erosion and deposition in the same area is unlikely except if there was a significant change in the gas velocity during the test. This was the case for the 100 hour shakedown test since the mass flow through the turbine test section decreased significantly after the first 50 hours due to plugging of the inlet orifice of the turbine test section upstream of the cascades.

ERA

N78-33224* Vermont Univ., Burlington
THERMODYNAMIC AND TRANSPORT PROPERTIES OF INTERSTITIAL HYDROGEN ISOTOPES IN METAL SYSTEMS Final Report, 1 Apr. 1969 - 31 Mar 1978

J S Brown 1978 19 p refs
 (Contract EY-76-S-02-3551)
 (COO-3551-44) Avail NTIS HC A02/MF A01

The results of work under AEC in 1969 to its conclusion under ERDA in 1978 are discussed. The initial objectives of the research and how these objectives have changed over the period are presented. All papers and conference talks which relate to 1969 through 1978 are listed. Current endeavors are summarized and the present status of the published literature is surveyed. In addition, a number of problems that are still unresolved are identified, and some directions that future research might take on the electronic and transport properties of PdH and PdD and liquid transition metals are indicated.

ERA

N78-33256# Department of Energy, Washington, D C
DEPARTMENT OF ENERGY POSITION PAPER ON ALCOHOL FUELS

Mar 1978 6 p
 (DOE/US-0001/1) Avail NTIS HC A02/MF A01

The supply, utilization and economic characteristics of alcohols (methanol and ethanol) and the major issues associated with their implementation are briefly described. The major elements in the current evaluation of alcohol fuels as a candidate for federally-assisted commercialization of a nonpetroleum fuel are also described. ERA

N78-33257# Arizona State Univ., Tempe Coll of Engineering and Applied Sciences

CONVERSION OF CELLULOSIC AND WASTE POLYMER MATERIAL TO GASOLINE Progress Report

J L Kuester Nov 1977 5 p refs

(Contract Ey-76-S-02-2982)

(COO-2982-21) Avail NTIS HC A02/MF A01

Improvements in the composition of pyrolysis gas produced by the Fischer-Tropsch catalytic reactor and operational difficulties are reported. The effects of pressure on product yields are discussed. ERA

N78-33258# California Univ., Berkeley Lawrence Berkeley Lab Energy and Environment Div

CATALYTIC CONVERSION OF SOLVENT REFINED COAL TO LIQUID PRODUCTS M.S. Thesis

Kylan F Tanner and Alexis T Bell Feb 1978 98 p refs

(Contract W-7405-eng-48)

(LBL-6807) Avail NTIS HC A02/MF A01

Catalytic reactions of solvent refined coal (SRC) were studied using mixed metal oxide and low melting Lewis acid catalysts in extracting solvent media. From characterization of the benzene- and cyclohexane-soluble products $ZnCl_2$ and $SnCl_2$ were determined to be the most effective at hydrogenating and solubilizing SRC while assisting in heteroatom removal. $ZnCl_2$ and $SnCl_2$ were also found to be more effective at producing oil-like products rather than asphaltene-like products. Further enhancement of the solubilization of SRC could be achieved by the addition of isopropanol to the Lewis acid-substrate-solvent reaction mixture. Dry HCl was also investigated for its effect on the solubilization of SRC. The solubilized products and residues were characterized and the effect of reaction temperature, hydrogen pressure, and catalyst loading on the yield of soluble products were studied. ERA

N78-33259# Battelle Columbus Labs., Ohio

FUELS FROM SUGAR CROPS Quarterly Report

E S Lipinsky, S Kresovich, T A McClure, and W T Lawhon
 31 Jan 1978 89 p refs

(Contract W-7405-eng-92-077)

(TID-28191, QR-3) Avail NTIS HC A05/MF A01

Substantial progress was made on both the agricultural and the processing aspects of these fuels from biomass research program. Harvesting operations were performed at all locations for both sugarcane and sweet sorghum. Although final yield data were not statistically analyzed, it is apparent that large gains in total biomass were achieved through the introduction of narrow row spacing. An agronomic demonstration of sweet sorghum production in the Midwest was carried out. The information collected indicated sweet sorghum showed considerable potential in the Midwest, provided that short season processing problems can be overcome. Total biomass yields reached values of 25.6 metric tons per hectare on a dry weight basis. Under nonirrigated conditions, it appeared that sweet sorghum was energy self-sufficient. Laboratory work on bagasse drying rates was initiated. ERA

N78-33261# Department of Energy, Bartlesville, Okla Energy Research Center

PERFORMANCE OF GASOLINE AND DIESEL FUELS PRODUCED FROM COED SYNCRUDE

R L Bechtold and R D Fleming Jun 1978 26 p refs

(BERC/RI-78/2) Avail NTIS HC A03/MF A01

Fuel consumption and exhaust emissions characteristics were evaluated for gasoline and diesel fuel produced from coal liquid derived syncrude. The engine types used were (1) current technology spark-ignition homogeneous charge, (2) stratified-charge, and (3) Stirling. There were no significant changes in fuel consumption or exhaust emissions between syncrude-derived fuels and conventional fuels in stratified-charge and Stirling engines. Because of its low (approximately equal to 70) synthetic gasoline required a reduction in compression ratio to achieve knock-limited, MBT spark timing. This was in comparison to the reference gasoline, in a single cylinder, spark ignited, test engine, at one speed/load point. Exhaust emissions were very similar between the two fuels. ERA

N78-33262# National Technical Information Service, Springfield, Va

ALCOHOL FUELS. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Jun. 1978

Diane M Cavagnaro Jul 1978 193 p Supersedes NTIS/PS-77/0620

(NTIS/PS-78/0673/0, NTIS/PS-77/0620) Avail NTIS HC \$28.00/MF \$28.00 CSCL 21D

The bibliography covers Federally-funded research on alcohol based fuels that might have to be used in the future as a fuel source. The citations cover synthesis, chemical analysis, performance testing, processing, pollution economics, environmental effects, and feasibility. GRA

N78-33263# National Technical Information Service, Springfield, Va

ALCOHOL FUELS. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - Jun. 1978

Diane M Cavagnaro Jul 1978 198 p Supersedes NTIS/PS-77/0621

(NTIS/PS-78/0674/8, NTIS/PS-77/0621) Avail NTIS HC \$28.00/MF \$28.00 CSCL 21D

The bibliography covers the different blends, synthesis, processes used, properties, engine performance evaluations, economics, safety measures, pollution effects, and combustion studies. The research also covers sources from which alcohol fuels can be obtained such as coal, solid wastes, industrial by-products, and agricultural wastes. GRA

N78-33264# Rosenstiel School of Marine and Atmospheric Sciences, Miami, Fla Div of Biology and Living Resources

PHOTOPRODUCTION OF HYDROGEN BY MARINE BLUE-GREEN ALGAE Progress Report, 15 Jun. - 15 Dec. 1977

Akira Mitsui 1977 53 p refs

(Grant NSF AER-77-11545)

(PB-280995/2, NSF/RA-770482)

Avail NTIS

HC A04/MF A01 CSCL 06A

A survey of tropical Atlantic marine photosynthetic organisms was conducted in order to find an organism exhibiting exceptionally high hydrogen producing capabilities. Such an organism was found in the form of a blue-green algal strain, Miami BG7. As part of an in-depth investigation of hydrogen production in this species, the mechanisms of this process and hydrogen photoproduction were studied. The use of various metabolic inhibitors to investigate the biochemical pathways of hydrogen production was investigated. Results indicate that the process is strongly photodependent. GRA

N78-33265# General Electric Co., Schenectady, N Y
FLOATING SUBSTRATE PROCESS: LARGE-AREA SILICON SHEET TASK LOW-COST SOLAR ARRAY PROJECT Final Report

M Garfinkel and R N Hall 23 Jun 1978 85 p

(Contract JPL-954350)

(NASA-CR-157759, DOE/JPL-954350-78/3) Avail NTIS

HC A05/MF A01 CSCL 13H

Supercooling of silicon-tin alloy melts was studied. Values as high as 78 C at 1100 C and 39 C at 1200 C were observed, corresponding to supersaturation parameter values 0.025 and

0053 at 1050 C and 1150 C, respectively. The interaction of tin with silane gas streams was investigated over the temperature range 1000 to 1200 C. Single-pass conversion efficiencies exceeding 30% were obtained. The growth habit of spontaneously-nucleated surface growth was determined to be consistent with dendritic and web growth from singly-twinned triangular nuclei. Surface growth of interlocking silicon crystals, thin enough to follow the surface of the liquid and with growth velocity as high as 5 mm/min, was obtained. Large area single-crystal growth along the melt surface was not achieved. Small single-crystal surface growth was obtained which did not propagate beyond a few millimeters. LS

N78-33274# National Bureau of Standards, Washington, D C
JOURNAL OF RESEARCH OF THE NATIONAL BUREAU OF STANDARDS, VOLUME 83, NO. 1, JANUARY - FEBRUARY 1978

1978 119 p refs

(PB-281311/1) Avail NTIS HC A06/MF A01 CSCL 07D
 Tubular flow reactors with first-order kinetics and units in magnetism are discussed. The first spectrum of ytterbium and norm approximation problems and normal statistics are also reviewed along with vector-valued entire functions of bounded index, satisfying a differential equation. GRA

N78-33291# National Aviation Facilities Experimental Center, Atlantic City, N J

TERMINAL RADAR INTERFERENCE CRITERIA STUDY Final Report, Jan. - Dec. 1976

John Kenton Jun 1978 84 p refs

(FAA Proj 213-061 110)

(AD-A057280 FAA-NA-77-20 FAA-RD-78-75) Avail NTIS HC A05/MF A01 CSCL 17/9

Tests were undertaken to investigate the relationship between pulsed-type interference and the air traffic controller working in the terminal area. This was done by recording a series of pulsed-type interference cases and combining them with simulated analog radar targets to form a set of scenarios for display to a group of Federal Aviation Administration (FAA) controllers. Several operational responses were used as performance measures to investigate interference criteria. The interference cases were then quantified and ordered based on two indexing schemes. Tests based on the indices and the performance measures revealed that correlations exist between the operational responses and the interference cases. Author

N78-33455# Department of Energy, Bartlesville, Okla Energy Research Center

PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES, SECOND SERIES, REPORT NO. 1: 1976 CHEVROLET VEGA 140 (CID (2.3 LITERS), 2V Interim Report

T W Chamberlain, D E Koehler, K R Stamper, and W F Marshall Apr 1978 62 p
 (Contract DOT-RA-76-23)

(PB-281774/0, BERC/OP-77/47-1, DOT-TSC-NHTSA-78-2, DOT-HS-803-275) Avail NTIS HC A04/MF A01 CSCL 21G

Experimental data were obtained in dynamometer tests of a 1976 Chevrolet Vega 2.3 liter, 140-CID engine to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, oxides of nitrogen) at steady-state engine operating modes. Engine performance data are presented for estimating emissions and fuel economy for varied engine service and duty. Basic engine characteristic data required as input for engineering calculations involving ground transportation are provided. GRA

N78-33456# Department of Energy, Bartlesville, Okla Energy Research Center

PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES, SECOND SERIES, REPORT NO. 2: 1976 CHEVROLET 305 CID (5.0 LITERS), 2V Interim Report, Aug 1977

T W Chamberlain, D E Koehler, K R Stamper and W F Marshall Apr 1978 60 p refs

(Contract DOT-RA-76-23)

(PB-281775/7, BERC/OP-77/47-2, DOT-TSC-NHTSA-78-3, DOT-HS-803-276) Avail NTIS HC A04/MF A01 CSCL 21G

Experimental data were obtained in dynamometer tests of a 1976 Chevrolet 305CID V-8 engine to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, oxides of nitrogen) at steady-state engine operating modes. Engine performance data for estimating emissions and fuel economy for varied engine service and duty are provided along with basic engine characteristic data required as input for engineering calculations involving ground transportation. GRA

N78-33457# Department of Energy, Bartlesville, Okla Energy Research Center

PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES, SECOND SERIES, REPORT NO. 3: 1977 CHRYSLER 225 CID (3.7 LITERS), 2V Interim Report, Aug. 1977

T W Chamberlain, D E Koehler, K R Stamper, and W F Marshall Apr 1978 62 p

(Contract DOT-RA-76-23)

(PB-281776/5, BERC/OP-77/48, DOT-TSC-NHTSA-78-4, DOT-HS-803-277) Avail NTIS HC A04/MF A01 CSCL 21G

Experimental data were obtained in dynamometer tests of a 1977 Chrysler 225-CID engine to determine fuel consumption and emission (hydrocarbon, carbon monoxide, oxides of nitrogen) at steady-state engine operating modes. Estimation of emissions and fuel economy for varied engine service and duty was emphasized. Engine data required as input for engineering calculations involving ground transportation are given. GRA

N78-33458# Department of Energy, Bartlesville, Okla Energy Research Center

PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES, FIRST SERIES, REPORT NO. 12: 1975 PERKINS DIESEL 247 CID (4.0 LITERS), FI Interim Report

W F Marshall and K R Stamper Apr 1978 36 p

(Contract DOT-RA-75-10)

(PB-281777/3, BERC/OP-77/28, DOT-TSC-NHTSA-78-5, DOT-HS-803-278) Avail NTIS HC A03/MF A01 CSCL 21G

Experimental data were obtained in dynamometer tests of a 1975 Perkins 247-CID diesel engine to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, oxides of nitrogen) at steady-state engine operating modes. Emissions and fuel economy for varied engine service and duty are estimated. Basic engine characteristic data required as input for engineering calculations involving ground transportation are presented. GRA

N78-33459# Department of Energy, Bartlesville, Okla Energy Research Center

PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES, FIRST SERIES, REPORT NO. 13: 1975 AMERICAN MOTORS, 258 CID (4.2 LITERS), 1V Interim Report, Jun. 1977

W F Marshall and K R Stamper Apr 1978 38 p

(Contract DOT-RA-75-10)

(PB-281778/1, BERC/OP-77/28, DOT-TSC-NHTSA-78-5, DOT-HS-803-279) Avail NTIS HC A03/MF A01 CSCL 21G

Experimental data were obtained in dynamometer tests of a 1975 AMC 258-CID production 1V engine to determine fuel consumption and emission (hydrocarbon, carbon monoxide, oxides of nitrogen) at steady-state engine operating modes. Emissions and fuel economy are estimated for varied engine service and duty. Basic engine characteristic data required as input for engineering calculations involving ground transportation are given. GRA

N78-33515# R and D Associates, Marina Del Rey, Calif
EVALUATION OF GEOTHERMAL ENERGY EXPLORATION AND RESOURCE ASSESSMENT, VOLUME 1: A REVIEW OF GEOTHERMAL SUBSIDENCE MODELING Final Report

M K Grover, J G Lewis, D Oberste-Lehn G E Rawson, and D S Srinivasa Dec 1977 296 p refs
(Contract EY-76-C-03-1269)
(SAN-1269-1-Vol-1, RDA-TR-0400-001-Vol-1) Avail NTIS HC A13/MF A01

Numerical modeling of subsidence phenomena associated with the production of fluid from geothermal reservoirs is evaluated. A comparative analysis of their potential for application to specific geologic environments where the subsidence may occur is presented. Guidelines for subsidence modeling application to assist program managers responsible for the supervision of subsidence monitoring and control measures associated with geothermal development are included. Data acquisition and management, a proposed method for qualitatively ranking the subsidence risks of a known geothermal reservoir, and data uncertainties management are reviewed. ERA

N78-33516# Westinghouse Electric Corp Pittsburgh, Pa
SENSOR APPLICATIONS STUDY TECHNICAL REPORT, TASK 1

1978 57 p refs
(Contract EY-76-C-02-4082)
(TID-27941) Avail NTIS HC A04/MF A01

Task 1 is a survey of well logging instrumentation undertaken to determine to what extent various tools can make use of severe environment acoustic sensor technology. The major goal was to establish the most appropriate tool for Task 2-Sensor Development and Optimization. Subject tools are borehole televiwer (BHTV) acoustic caliper, acoustic velocity logger, down hole flow meter (DHFM) and passive listening monitor. This report describes the investigation of tool capabilities, applications operation and limitations under present and anticipated geothermal conditions. Acoustic velocity logger and passive listening devices are viewed as playing an important but lower priority role in geothermal resource characterization and development. ERA

N78-33520# General Accounting Office, Washington D C
Community and Economic Development Div
BENEFITS DERIVED FROM THE OUTER CONTINENTAL SHELF ENVIRONMENTAL STUDIES PROGRAM ARE QUESTIONABLE

1 Jun 1978 33 p refs
(PB-281782/3, CED-78-93) Avail NTIS HC A03/MF A01
CSCL 081

The Outer Continental Shelf environmental studies program is costly and may do little toward minimizing environmental damage during oil and gas exploration development, and production in the Outer Continental Shelf. Uncertainties about program effectiveness are exemplified in the Alaska studies program. GAO believes that the Outer Continental Shelf environmental studies program needs to be reassessed for how it can best be used in the decision making process, what information is needed, and the type of plans that are necessary. This report includes recommendations to the Secretaries of the Interior and Commerce. GRA

N78-33521# General Accounting Office, Washington, D C
Energy and Minerals Div
LOWER COOK INLET ANOTHER EXAMPLE OF MORE DATA NEEDED FOR APPRAISING OUTER CONTINENTAL SHELF OIL AND GAS RESOURCES Report to the Congress

8 Jun 1978 56 p refs
(PB-281769/0 EMD-78-48) Avail NTIS HC A04/MF A01
CSCL 081

Improved methods for selecting and evaluating outer continental shelf lands for oil and natural gas exploration are discussed. One hundred thirty-five oil and gas tracts off the southern Alaskan coast, Lower Cook Inlet, were offered for lease to the highest industry bidders. Two types of bidding systems used were cash bonus bid with a fixed royalty and required bonus with a percentage royalty bid. The revenue received from the lease tracts was about 398.5 million. GRA

N78-33522# Federal-State Land Use Planning Commission for Alaska, Anchorage

LAND USE PLANNING ISSUES AND THE ALASKA GAS PIPELINE A REPORT TO THE PRESIDENT

Walter B Parker, Jerry D Kreitner, Dennis M Dooley, and Kris Hoeltgen Aug 1977 120 p refs
(PB-281327/7) Avail NTIS HC A06/MF A01 CSCL 10A

Information needed for the selection of an appropriate route for transportation of Alaska North Slope gas is given. Broad social, economic, and environmental concerns are presented. Topics considered include the following: design and routing implications of the Alaskan gas pipeline proposals, suggested outline for policy development relating to long-term Alaska oil and gas development and transportation system, and a review of the status of Canadian native land claims. GRA

N78-33524 Pennsylvania State Univ., University Park
HIGH-TEMPERATURE LINEAR RADIATION-CAVITY SOLAR COLLECTOR WITH A FRESNEL CONCENTRATOR
Ph.D. Thesis

Zenen Igor Antoniak 1978 234 p
Avail Univ Microfilms Order No 7812029

A model solar-thermal concentrator-collector that is 1/6th scale relative to a system considered to be of practical dimensions for power generation was constructed and tested. It consists of a mirror-concentrator, a receiver pipe, a graphite absorber, and a gaseous heat transfer medium. The mirror-concentrator utilizes 40 suitably tilted reflective strips mounted in a parallel planar array which moves east-west. The effect of various parameters such as insulation thickness, aperture width, and antireflective coatings were investigated in an optimization study of the proposed full-scale collector. Aperture width, aperture emittance, and mirror reflectance exert the strongest influence on exit temperature and collector efficiency. Dissert Abstr

N78-33525 Carnegie-Mellon Univ Pittsburgh Pa
SIGNIFICANCE OF PROCESS VARIABLES ON LIQUID EFFLUENT PRODUCTION IN COAL GASIFICATION
Ph.D. Thesis

David Vincent Nakles 1978 312 p
Avail Univ Microfilms Order No 7814230

The production of liquid effluents condensable hydrocarbons and water soluble contaminants, was investigated. Significant variations in tar, phenol, chemical oxygen demand, and total organic carbon production occur during transient operating periods, i.e., start-up or shutdown and between steady state operations at different gasifier operating conditions. In particular, changes in conditions which enhance the approach of effluent species to chemical equilibrium dramatically influence steady state liquid effluent production. Increasing gas-solid contacting, the final reaction temperature and residence time of the devolatilized species in the hot zone of the reactor reduce organic liquid effluent production significantly. Near complete extinction of these compounds is possible by providing the appropriate combination of coal devolatilization conditions and product gas residence time. Dissert Abstr

N78-33526* National Aeronautics and Space Administration
Pasadena Office, Calif

HYDROGEN-FUELED ENGINE Patent

Eugene A Lauman (JPL) and Rollins K Reynolds, inventors (to NASA) (JPL) Issued 12 Sep 1978 6 p Filed 27 Aug 1976
Supersedes N77-11398 (15 - 02 p 0200) Sponsored by NASA
(NASA-Case-NPO-13763-1, US-Patent-4,112,875
US-Patent-Appl-SN-718268 US-Parent-Class-123-DIG 12
US-Patent-Class-123-1A US-Patent-Class-123-3) Avail US Patent Office CSCL 10A

A hydrogen-oxygen fueled internal combustion engine is described which utilizes an inert gas such as argon as a working fluid to increase the efficiency of the engine, eliminate pollution, and facilitate operation of a closed cycle energy system. In a system where sunlight or other intermittent energy source is available to separate hydrogen and oxygen from water, the oxygen and inert gas are taken into a diesel engine into which hydrogen is injected and ignited. The exhaust is cooled so that it contains

only water and the inert gas. The inert gas in the exhaust is returned to the engine for use with fresh oxygen while the water in the exhaust is returned to the intermittent energy source for reconversion to hydrogen and oxygen.

Official Gazette of the U.S. Patent Office

N78-33527*# Honeywell, Inc., Minneapolis, Minn
DEVELOPMENT OF FLAT-PLATE SOLAR COLLECTORS FOR THE HEATING AND COOLING OF BUILDINGS: EXECUTIVE SUMMARY

[1978] 21 p

(Contract NAS3-17862)

(NASA-CR-134804) Avail NTIS HC A02/MF A01 CSCL 10A

An efficient, low cost, flat-plate solar collector was developed. Computer aided mathematical models of the heat process in the collector were used in defining absorber panel configuration, determining insulation thickness, and in selecting the number, spacing, and material of the covers. Prototypes were built and performance tested. Data from simulated operation of the collector are compared with predicted loads from a number of locations to determine the degree of solar utilization. S B S

N78-33528*# Owens-Illinois, Inc., Toledo, Ohio
INSTALLATION PACKAGE FOR SUNPAK SOLAR COLLECTORS

Sep 1978 13 p refs Prepared for DOE

(Contract NAS8-32259)

(NASA-CR-150802) Avail NTIS HC A02/MF A01 CSCL 10A

A subsystem (air/liquid vacuum collector) was developed for use with solar combined heating and cooling subsystems. The collector is modular in design, is approximately twelve-feet-three-inches wide and is eight-feet-seven-inches high. The module contains 72 collector tube elements and weighs approximately 300 pounds. G G

N78-33529*# Northrup Inc., Hutchins Tex
DEVELOPMENT AND FABRICATION OF A CONCENTRATING SOLAR COLLECTOR SUBSYSTEM Quarterly Reports, 1 Jan. 1978 - 30 Jun. 1978

Jul 1978 67 p Prepared for DOE

(Contract NAS8-32251)

(NASA-CR-150787) Avail NTIS HC A04/MF A01 CSCL 10A

Testing and evaluation results for the structural design of the concentrating solar collector and the attitude control system are reported. G G

N78-33530*# Houston Chemical Co., Corpus Christi Tex
SOLAR HEAT TRANSPORT FLUID Quarterly Report, May 1978 - Aug 1978

Sep 1978 11 p Prepared for DOE

(Contract NAS8-32255)

(NASA-CR-150806) Avail NTIS HC A02/MF A01 CSCL 10A

The development and delivery of noncorrosive fluid subsystems are reported that are compatible with closed-loop solar heating or combined heating and hot water systems. They are also compatible with both metallic and non-metallic plumbing systems. The performance testing of a number of fluids is described. G G

N78-33531*# Solafern Ltd., Bourne, Mass
DESIGN PACKAGE FOR A COMPLETE RESIDENTIAL SOLAR SPACE HEATING AND HOT WATER SYSTEM

Sep 1978 68 p Prepared for DOE

(Contract NAS8-32246)

(NASA-CR-150795) Avail NTIS HC A04/MF A01 CSCL 10A

Information necessary to evaluate the design of a solar space heating and hot water system is reported. System performance specifications, the design data brochure, the system description, and other information pertaining to the design are included. G G

N78-33532*# CALMAC Mfg Co, Englewood, N J
CERTIFICATION AND VERIFICATION FOR CALMAC FLAT PLATE SOLAR COLLECTOR

Sep 1978 159 p Prepared for DOE

(Contract NAS8-32253)

(NASA-CR-150784 Rept-77S1111)

Avail NTIS

HC A08/MF A01 CSCL 10A

Information used in the certification and verification of the Calmac Flat Plate Collector is presented. Contained are such items as test procedures and results, information on materials used, installation operation and maintenance manuals, and other information pertaining to the verification and certification. G Y

N78-33533*# Bechtel International Corp., San Francisco Calif
MODULE/ARRAY INTERFACE STUDY Final Report

Aug 1978 128 p refs Sponsored by NASA Prepared for DOE and JPL

(Contract JPL-954698)

(NASA-CR-157774 DOE/JPL 954698-78/1) Avail NTIS HC A07/MF A01 CSCL 10A

Several aspects of module design are evaluated including glass superstrate and metal substrate module configurations, the potential for hail damage, light absorption in glass superstrates, the economics of glass selection, and electrical design. Also three alternate glass superstrate module configurations are evaluated by means of finite element computer analyses. Two panel sizes, 1.2 by 2.4 m (4 by 8 ft) and 2.4 by 4.8 m are used to support three module sizes, 0.6 by 1.2 m, 1.2 by 1.2 m, and 1.2 by 2.4 m, for design loadings of + or - 17 kPa, + or - 2.4 kPa, and + or - 3.6 kPa. Designs and cost estimates are presented for twenty panel types and nine array configurations at each of the three design loadings. Structural cost sensitivities of combined array configurations and panel cases are presented. L S

N78-33534*# Bechtel Corp., San Francisco Calif
Research and Engineering Operation

TERRESTRIAL CENTRAL STATION ARRAY LIFE-CYCLE ANALYSIS SUPPORT STUDY Final Report

Aug 1978 211 p refs Sponsored by NASA Prepared for JPL

(Contract JPL-954848)

(NASA-CR-157772, DOE/JPL-954848-78/1) Avail NTIS HC A10/MF A01 CSCL 10B

Plant elements evaluated included designs for module, panel and array structures, as well as balance-of-plant systems. Installation and maintenance procedures and the impact of site environment were also evaluated. In terms of the cost of energy produced, the horizontal array configuration was found to be less expensive than the tandem array at latitudes less than 40 deg. Both of these configurations are less expensive than the rack design. However, the costs of energy for all three configurations are within approximately ± 10 percent of each other. For flat plate panels, the seasonally adjusted and tracking array configurations are not economically attractive when compared to the three other designs. Balance-of-plant costs are approximately equal to (goal) module costs. The array structures and foundations are the most expensive items in the balance-of-plant costs. L S

N78-33537*# Martin Marietta Aerospace, Denver, Colo
APPLICATIONS OF THERMAL ENERGY STORAGE IN THE CEMENT INDUSTRY Final Report, Sep. 1977 - Mar 1978

F A Jaeger, D G Beshore, F M Miller and E M Gartner
 Oct 1978 205 p refs Sponsored by NASA Prepared in cooperation with Portland Cement Assoc

(Contracts EC-77-C-01-5084, EC-77-A-31-1034)

(NASA-CR-159399, CONS/5084-1)

Avail NTIS

HC A10/MF A01 CSCL 10C

In the manufacture of cement, literally trillions of Btu's are rejected to the environment each year. The purpose of this feasibility study program was to determine whether thermal energy storage could be used to conserve or allow alternative uses of this rejected energy. This study identifies and quantifies the sources

of rejected energy in the cement manufacturing process, established use of this energy, investigates various storage system concepts and selects energy conservation systems for further study. Thermal performance and economic analyses are performed on candidate storage systems for four typical cement plants representing various methods of manufacturing cement. Through the use of thermal energy storage in conjunction with waste heat electric power generation units an estimated 2.4 x 10 to the 13th power Btu/year, or an equivalent on investment of the proposed systems are an incentive for further development. Author

N78-33540# Energy Research Corp., Danbury, Conn
REVERSIBLE METAL HYBRIDE-AIR FUEL CELL Final Report, Feb. 1977 - Feb. 1978

Michael George and Joseph Scozzafava Jun 1978 38 p refs (Contract DAAB07-77-C-2644 DA Proj 1G7-63702-DG-10) (AD-A056591, ECOM 77-2644-F) Avail NTIS HC A03/MF A01 CSCL 10/2

A 60 watt portable power fuel cell system has been built operating on ambient air and hydrogen as supplied by the deactivation of lanthanum nickel hydride. The use of the endothermic hydride deactivation process in conjunction with the fuel cell considerably reduced steady state system operating temperatures. The hydride reaction was initially sustained through use of heating coil, but thereafter could be maintained at 20 C by transferring waste heat from the fuel cell. Author (GRA)

N78-33541# Energy Research Corp., Danbury, Conn
A 15 kW METHANOL FUEL CELL POWERPLANT Final Report

S G Abens, M Lambrecht, P Marchetti, I Michalko, and D Patel Apr 1978 155 p refs (Contract DAAG53-76-C-0118, DA Proj 1L7-63702-DG-10) (AD-A057145) Avail NTIS HC A08/MF A01 CSCL 10/2

A 15 kW indirect methanol fuel cell powerplant was constructed and tested. A methanol steam reformer was used in conjunction with a phosphoric acid fuel cell stack. Output voltage was adjustable between 26 and 34 volts, and automatic unattended operation was provided by a controller. Fuel consumption was 2.1 lb MeOH/Kwhr at rated power and 1.1 lbs MeOH/hr during standby. The powerplant was delivered to USA MERADCOM. 2 water recovery study for the powerplant was conducted. Author (GRA)

N78-33542# Burns and Roe, Inc., Woodbury, N Y
USAF TERRESTRIAL ENERGY STUDY VOLUME 3, PART 2 ENERGY CONSERVATION SYSTEMS HANDBOOK Final Report, 1 Apr 1976 - 1 Feb. 1978

A Carlson, D Fuller, R Reyer, C Mallner, and S Fogelson May 1978 483 p refs (Contract F33615-76-C-2171) (AD-A057252, AFAPL-TR-78-19-Vol-3-Pt-2) Avail NTIS HC A21/MF A01 CSCL 10/2

This report was prepared by Burns and Roe, Inc. to serve as a guide for the U S Air Force in selecting types of energy conversion systems to meet their future ground power requirements. The electric power requirements included in this report range from 10 kilowatts to 50 megawatts. Twenty-one types of systems, conventional as well as advanced, are considered. These include 19 types of energy conversion systems which utilize either chemical fuel, nuclear fuel, solar energy or wind energy and two types of energy storage systems which utilize electric power for recharging. Each system is characterized in terms of a set of economic, physical and performance parameters including acquisition costs, life cycle costs, size, efficiency and environmental constraints. A total of eighteen such parameters are presented for each type of system for several sets of requirements. The requirements are defined in terms of electric power level, frequency and duration of operation corresponding to typical U S Air Force ground applications. Author (GRA)

N78-33545# Battelle Pacific Northwest Labs., Richland, Wash
COMPRESSED AIR ENERGY STORAGE ADVANCED SYSTEMS ANALYSIS Progress Report, FY 1977

D K Kreid and M A McKinnon Mar 1978 133 p refs (Contract EY-76-C-06-1830) (PNL-2464) Avail NTIS HC A07/MF A01

Technologies that will reduce the consumption of natural gas and oil are reviewed. Major areas of interest for the compressed air energy storage (CAES) program are cost assessment for thermal energy storage (TES) systems that are suitable for CAES applications, potential fuel savings of hybrid CAES cycles that incorporate TES for recovery of the heat of compression and estimate the economic incentive for using TES in CAES systems and modified CAES cycles that eliminate the use of gas and oil by the use of alternative fuels. ERA

N78-33546# Battelle Pacific Northwest Labs., Richland, Wash
ECONOMIC FEASIBILITY OF STRONTIUM-90 FUELED HEATERS FOR USE IN COLD REGIONS

W E Sande and R L Aaberg Feb 1978 54 p refs (Contract EY-76-C-06-1830) (PNL-2476) Avail NTIS HC A04/MF A01

Cost estimates for various radioisotope fueled heating systems are given. The economic feasibility of radioisotope fueled heaters was determined by comparing them to fuel oil systems. The basic conceptual heat design considered were a heat source and radiation shielding with no external heat transfer equipment. Radioisotope heaters were much more expensive than fuel oil systems. The radioisotope fuel costs contribute 50 percent or more to the overall cost. An effective method to make a substantial reduction in radioisotope system cost would be to lower the Sr price from 10 cents/curie. Radioisotope heaters will not be economically competitive with fuel oil systems unless the price of strontium-90 is reduced below 10 cents/curie, fuel oil prices increase significantly or for a particular application the reliability or adaptability of a fuel oil system is unacceptable and a radioisotope system is satisfactory. ERA

N78-33547# Criterion Analysis, Inc., Dallas, Tex
APPRAISAL OF ENERGY ANALYSIS Final Report

F J Alessio, B L Jackson, and D B Cohen Mar 1978 109 p refs (EPRI-EA-504) Avail NTIS HC A06/MF A01

The methods and applications of energy analysis are reviewed and evaluated. Energy analysis is viewed in the broadest possible context, with a broad range of conclusions reached. Energy analysis is a useful complement to economic analysis in technological assessments and public policy decision making. ERA

N78-33548# Department of Energy, Washington, D C Office of Business Assistance Programs
VOLUNTARY BUSINESS ENERGY CONSERVATION PROGRAM Progress Report

Apr 1978 161 p (DOE/CS-0018/6, PR-6) Avail NTIS HC A08/MF A01

Data are compiled from 48 industry and trade associations representing 3,000 firms. Progress in energy conservation in the Voluntary Business Energy Conservation Program is reported. In the first six months of 1977 the Program's index of business energy efficiency was running at an estimated 9.2 percent above the 1972 base level. This increase is mostly attributable to sizable gains for the chemicals and petroleum industries, although energy use improvements were generally widespread. However, moderate declines were recorded in the indexes for primary metals, foods, and textile industries. ERA

N78-33549# Federal Energy Administration, Washington, D C Office of Energy Conservation and Environment
FEDERAL ASSISTANCE PROGRAMS AND ENERGY-DEVELOPMENT-IMPACTED MUNICIPALITIES

Feb 1976 107 p refs. Sponsored by DOE (FEA/D-77/039) Avail NTIS HC A06/MF A01

A Federal assistance program that does or could provide aid for very small communities impacted by major energy developments is reviewed. The discovery of oil, coal, or other energy sources in sparsely populated Western U S areas would

create boom towns that would need the rapid development of facilities and manpower to provide public safety, public utilities, education, transportation and health care. The federal assistance programs in the areas are described and methods for expediting and delivering such aid are discussed. ERA

N78-33550# Institute for Energy Analysis Oak Ridge, Tenn
LIMITS TO ENERGY CONSERVATION IN CHEMICAL PROCESSES

W Gool Apr 1978 30 p refs

(Contract EY-76-C-05-00333)

(ORAU/IEA-78-6(M)) Avail NTIS HC A03/MF A01

A national policy for energy conservation is handicapped by two shortcomings. First the objectives of energy conservation are poorly defined in many national policies. Second no accepted yardstick is available by which to determine the priorities for different conservation projects. A general approach to establish a common conservation measure is described in this paper. Use of the thermodynamic limit to evaluate the conservation potential is shown to be inappropriate. For each production rate a real energy minimum exists, and it does not correspond to the thermodynamic limit. A simplified model is applied to an average kind of energy-intensive chemical production. The characteristics of the cost minimum and the energy minimum are used to derive a value in dollars per megajoule of energy saved and the importance of this value for ranking priorities in a national energy policy is explained. ERA

N78-33551# Resource Planning Associates, Inc Cambridge Mass

POTENTIAL FOR COGENERATION DEVELOPMENT IN SIX MAJOR INDUSTRIES BY 1985

Dec 1977 217 p refs Sponsored by DoE

(HCP/M60172-01/2) Avail NTIS HC A10/MF A01

Industrial cogeneration development potential both without and with government action was estimated for six industries that consume a significant amount of electricity and process heat: chemicals, petroleum refining, pulp and paper, steel food processing, and textiles. Process-steam topping applications were studied because the initial analysis of industrial cogeneration potential indicated that 60 to 70 percent of the potential development is in these applications. The 1985 thermal energy requirements for process use in industry were projected at 17,900 trillion Btu--13,900 trillion Btu for process steam and 4,000 trillion Btu for direct process heat. The 1985 waste heat bottoming cogeneration potential in the six focus industries was estimated to be 3,540 trillion Btu predominantly (2,760 trillion Btu) in the chemical, steel and refining industries. A maximum technical potential for cogeneration of 380 to 740 billion kWh of electric energy produced was used to estimate an energy savings of 1.0 to 1.6 million bbl/day oil equivalent. ERA

N78-33552# Department of Energy, Laramie, Wyo Energy Research Center

THERMAL CONVERSION OF OIL-SHALE KERGEN USING CO AND WATER AT ELEVATED PRESSURES

J J Cummings and W E Robinson 1978 21 p refs

(LERC-78/1) Avail NTIS HC A02/MF A01

Temperature, heating time, pressure, presence or absence of mineral carbonates, shale particle size, shale grade, presence of organic solvents and amount of water were investigated as variables affecting kerogen conversion. Higher conversions of kerogen at low temperatures were obtained by using the CO-H₂O reaction and CO-H₂O-solvent reaction than by dry thermal processes. The soluble degradation products from the kerogen have elemental compositions similar to shale oils and would be suitable materials for hydrocracking and refining feedstocks. Other advantages are good conversion of extremely rich oil shales and good conversion of finely ground oil shale. Water-soluble minerals are removed from the shale residue during the reaction and are recovered as a valuable byproduct with significant environmental advantage. ERA

N78-33553# Burt, Hill Kosar Rittleman, and Associates, Butler, Pa

MINIMUM ENERGY DWELLING (MED) WORKBOOK: AN INVESTIGATION OF TECHNIQUES AND MATERIALS FOR ENERGY CONSCIOUS DESIGN

Dec 1977 430 p

(Contract EY-76-C-03-1198)

(SAN-1198-1) Avail NTIS HC A10/MF A01

A workbook is presented based upon information gathered during the design phase of the Minimum Energy Dwelling. The objective of the project is to substantially reduce energy use by the incorporation of energy conservation and solar techniques in a single-family detached dwelling. The Project demonstrates to builders, as well as to the general public, a number of technological innovations that can at reasonable cost be included in a dwelling design. ERA

N78-33554# Department of Energy, Washington D C
ENVIRONMENTAL DEVELOPMENT PLAN FOR ELECTRIC ENERGY SYSTEMS PROGRAM, 1977

G Hagey and L T Krezanosky Mar 1978 103 p

(DOE/EDP-0016) Avail NTIS HC A06/MF A01

A framework is provided for incorporating environmental considerations into the planning process at the earliest stage, resolving environmental concerns concurrently with the technology development, and ensuring that adverse environmental effects are mitigated through sound technological design. This Environmental Development Plan addresses the Electric Energy System Program which includes the following technologies: overhead ac/dc transmission, underground transmission (including superconducting transmission), generation storage applications, systems development and forecasting studies and systems control studies. ERA

N78-33555# Department of Energy, Washington, D C
ENVIRONMENTAL DEVELOPMENT PLAN FOR CONSERVATION RESEARCH AND TECHNOLOGY PROGRAM, 1977

D Moses and M Shapiro Mar 1978 77 p refs

(DOE/EDP-0017) Avail NTIS HC A05/MF A01

The Conservation Research and Technology (CONRT) EDP covers the environmental concerns related to CONRT technology R and D, whereas the end-use division EDPs cover the environmental concerns of system demonstrations and applications. Environmental strategy needs, objectives of this program, and technique for screening applicable projects are covered. Middle-grade heat utilization, alternative fuels, 4.8-MW(e) fuel-cell power plant development, and first-generation systems development are characterized. Scientific disciplines that were investigated to point out environmental concerns are organic Rankine bottoming cycle, biphasic system resource assessment, wood-fired and waste-fired boilers and fuel cells. The strategy for resolving environmental concerns is discussed. ERA

N78-33556# Department of Energy Washington D C
ENVIRONMENTAL DEVELOPMENT PLAN FOR THE DIVISION OF TRANSPORTATION ENERGY CONSERVATION, 1977

D Maxfield and D Moses Mar 1978 172 p refs

(DOE/EDP-0018) Avail NTIS HC A08/MF A01

The ecosystem, resource, physical environment, health safety and socio-economic issues associated with the research, development, demonstration and assessment of thirteen transportation technologies are identified. These include the Stirling and gas turbine engines, constant speed accessory drive system, bottoming cycle for heavy duty trucks, continuously variable transmission, new hydrocarbons (brood-cut petroleum fuels), alcohol and synthetic fuels, hydrogen electric and hybrid vehicles, pipeline bottoming cycle, and stratified-charge concept. A research and assessment strategy for resolving any potentially adverse environmental issues stemming from these technologies is presented. The process provides a framework for incorporating environmental consideration into agency planning processes at the earliest stages, resolving environmental issues concurrently with energy technology development and assuring that adverse environmental effects are mitigated through sound technological design and are at the same level of importance as technological, fiscal, and institutional issues in decision-making. ERA

N78-33557# Department of Energy, Washington, D C
**SIMPLE ECONOMIC MODEL FOR ENERGY RESEARCH AND
 SUPPLY STRATEGIES, DRAFT**
 G H Canavan and V H Reis Apr 1978 76 p refs
 (DOE/ER-0005/D) Avail NTIS HC A05/MF A01

A simple transparent model of energy economics. The model can be used to determine energy prices and flows under a reasonable range of resource and policy constraints. The model is based on familiar concepts of the equilibration of demand and supply to determine prices and flows. Demand structures are based on more sophisticated models. Supply structures are a combination of a simple physical model for the motion of supply curves of depletable resources, exogenous prescription of supplies from those sources for which environmental or social pressure subordinate economics to policy, and highly aggregated models for the penetration of new alternative energy systems as a function of their price, date of availability, and maximum growth rate. The model is calibrated by comparison with a more fundamental model which operates at roughly the same level of source aggregation. ERA

N78-33558# Los Alamos Scientific Lab., N Mex
**PRELIMINARY OPTIMIZATION MODEL FOR ASSESSMENT
 OF ENERGY DEVELOPMENT IN THE ROCKY MOUNTAIN
 REGION**

G Hinman, C Kolstad, G Morris, R Palmer, and R Pendley
 Mar 1978 61 p
 (Contract W-7405-eng-36)
 (LA-6689-MS) Avail NTIS HC A04/MF A01

A linear programming model was developed to determine the most economically efficient way (subject to environment and other constraints) in which extraction, conversion, and transportation of energy forms can take place to satisfy demands. A description of the model includes preliminary specification in some detail a discussion of input data and some characteristic outputs, drawbacks in the preliminary version, and model refinements. ERA

N78-33559# Los Alamos Scientific Lab., N Mex
CONTRIBUTION OF CHEMISTRY TO ENERGY
 Kenneth E Cox 1978 23 p refs Presented at Div of Fuel
 Chem Meeting Anaheim Calif., 12-17 Mar 1978
 (Contract W-7405-eng-36)
 (LA-UR-78-706, Conf-780305-15) Avail NTIS
 HC A02/MF A01

Several examples of chemical research being done to solve the problems of energy supply both for near-term and long-term are described. Energy conversion and storage is discussed with emphasis on the conversion of water to hydrogen as an energy supply medium to satisfy societal demand. BB

N78-33560# AirResearch Mfg Co., Torrance, Calif
**STUDY OF HEAT ENGINE/FLYWHEEL. HYBRID PROPULSION
 CONFIGURATION WITH ELECTRICAL TRANSMISSION
 SYSTEM, PHASE 1 Final Report**
 Apr 1978 151 p refs
 (Contract EY-76-C-04-0789)
 (ALO-41/1) Avail NTIS HC A08/MF A01

Mechanical and electronic options for the system were evaluated in a five passenger family sedan and were ranked according to cost, weight, and fuel economy. The primary use of this transmission system is to augment the heat engine with energy from the flywheel in such a manner as to level engine loads and improve the overall vehicle efficiency. The benefits of using this system are as follows: (1) provides fuel economy, which is unobtainable with conventional propulsion arrangements, (2) acceleration and passing performance same as provided by large V-8 engine, (3) meets 1985 Federal emission standards, (4) reduces direct operating cost for the consumer, and (5) reduces heat engine size. The hybrid's fuel consumption is 39.5 mpg, compared to 15 mpg projected for a conventional vehicle. This represents a 263% improvement in fuel economy. The hybrid also provides a 40% savings in direct operating cost. ERA

N78-33561# Sandia Labs., Albuquerque, N Mex
**SOLAR TOTAL-ENERGY LARGE-SCALE EXPERIMENT AT
 SHENANDOAH, GEORGIA**
 R W Hunke 1978 14 p refs Presented at Symp on
 Solar-Thermal Power Stations, Cologne, West Germany, 12 Apr
 1978

(Contract EY-76-C-04-0789)
 (SAND-77-2075C, Conf-780425-1) Avail NTIS
 HC A02/MF A01

The background, goals, objectives, and status of the solar total-energy system are outlined. The system is designed to make maximum use of collected solar energy by supplying both the low-grade (low-temperature thermal) and high-grade (electrical and/or mechanical) energy needs of selected applications. ERA

N78-33562# WESTEC Services, Inc., San Diego, Calif
**ENGINEERING AND ECONOMIC FEASIBILITY OF UTILIZING
 GEOTHERMAL HEAT FROM THE HEBER RESERVOIR
 FOR INDUSTRIAL PROCESSING PURPOSES AT VALLEY
 NITROGEN PRODUCERS INC., EL CENTRO AGRICULTURAL
 CHEMICAL PLANT Final Report**
 P B Sherwood and K L Newman Sep 1977 200 p refs
 (Contract EY-76-C-03-1323)
 (SAN-1323-3) Avail NTIS HC A09/MF A01

The analysis proceeds through the preliminary economics to determine the restraints imposed by geothermal modification size on internal rates of return, and through the energy utilization evaluation to determine the best method for substituting geothermal energy for existing fossil fuel energy. Finally, several geothermal utilization schemes were analyzed for detailed cost-benefit evaluation. An economically viable plan for implementing geothermal energy in the VNP Plant was identified and the final conclusions and recommendations were made based on these detailed cost-benefit analyses. Cost associated with geothermal energy production and implementation were formulated. ERA

N78-33563# Department of Energy, Washington, D C
**DEMONSTRATION PROJECT AS A PROCEDURE FOR
 ACCELERATING THE APPLICATION OF NEW TECHNOLOGY.
 CHARLIE TASK FORCE REPORT, VOLUME 1**
 Feb 1978 48 p 2 Vol
 (Contract EX-76-C-01-2295-006)
 (DOE/RA-0003/1-Vol-1) Avail NTIS HC A03/MF A01

Following the establishment on January 19, 1975, of the Energy Research and Development Administration, the Task Force on Demonstration Projects was organized to assist the new agency in evaluating its planning and management of its projects. The agency was to support research and development in energy-related areas, to be applied to the civil sector. The agency was also authorized to support the commercialization of new energy technology. The Task Force concluded it could not adequately provide guidance or demonstrations without examining ERDA's general commercialization role as defined in the statute. The Task Force decided to concentrate on these general aspects of the subject. The Task Force's general conclusions and recommendations on ERDA's overall commercialization role are given along with its specific consideration of the demonstration project and the demonstration project guidelines. ERA

N78-33564# Department of Energy, Washington, D C
**DEMONSTRATION PROJECT AS A PROCEDURE FOR
 ACCELERATING THE APPLICATION OF NEW TECHNOLOGY.
 CHARLIE TASK FORCE REPORT, VOLUME 2**
 Feb 1978 481 p 2 Vol
 (Contract EX-76-C-01-2295-006)
 (DOE/RA-0003/2-Vol-2) Avail NTIS HC A20/MF A01

The issues associated with government programs proposed for the commercialization of new energy technologies are examined. These include: (1) the role of research and development within the structure of the national energy goals and policies, (2) the process of technological change as it occurs with respect to energy technologies in terms of sources of misalignment of

social and private incentives, (3) correction of the sources of misalignment as the goal of commercial demonstration programs, and (4) circumstances under which government supported commercialization is likely to affect the success of subsequent stages of technological change. Methods for evaluation and planning of commercial demonstration programs are analyzed.

N78-33565# Battelle Pacific Northwest Labs., Richland, Wash
ANALYSIS OF FEDERAL INCENTIVES USED TO STIMULATE ENERGY PRODUCTION AN EXECUTIVE SUMMARY

B W Cone, D L Brenchley, V L Brix, M L Brown, K E Cochran, R J Cole, M G Curry, R Davidson, J Easterling, and A G Fassbender. Mar 1978. 15 p.
 (Contract EY-76-C-06-1830)
 (PNL-2410) Avail NTIS HC A02/MF A01

An analysis was made of past and present Federal incentives to production of various energy sources and thereby assist the Division of Solar Energy, Energy Research and Development Administration, in the study and recommendation of Federal incentives for the development of solar energy. The research was divided into five parts: a survey of current thought about incentives for solar energy production, the theoretical approach to analyzing and characterizing incentives, a generic view of the energy incentive-creating landscape for 1976, analysis of the major energy sources along their trajectories from exploration to waste management, including their costs in 1976 dollars, and insights into potential incentives for solar policy. Economic, political, organizational, and legal viewpoints were considered in formulating the typology of incentives. ERA

N78-33566# Aerotherm Acurex Corp., Mountain View, Calif
SOLAR TOTAL ENERGY SYSTEM: LARGE SCALE EXPERIMENT PHASE 2: CONCEPTUAL DESIGN Final Technical Progress Report

C D Hartman. Sep 1977. 275 p.
 (Contract EG-77-C-04-3986, Proj 7354)
 (SE-3986-1) Avail NTIS HC A12/MF A01

A conceptual design of a solar total energy system for a knitwear factory in Shennandoah, Georgia was completed. A key design objective was to maximize the cost effectiveness of collected solar energy while using it to supply at least 60 percent of the total annual energy requirements of the plant. The design features a distributed solar energy receiver system with sun-tracking parabolic trough collectors oriented north-south, two toluene Rankine cycle turbogenerators, absorption cycle and vapor compression cycle water chillers, and high temperature oil/rock bed storage reservoirs. One turbogenerator at a minimum meets the solar energy system's own demand for electricity with heat rejected for this turbine used to generate steam for the factory. When additional solar energy is available, the additional electricity and heat from this turbine drives the vapor compression and absorption chillers to produce cold water for the plant's air-conditioning system. The second turbogenerator is designed to convert solar energy to electricity for the plant at maximum efficiency. ERA

N78-33567# Idaho National Engineering Lab., Idaho Falls
RESIDENTIAL SPACE HEATING COST. GEOTHERMAL VS CONVENTIONAL SYSTEMS

I A Engen. Feb 1978. 49 p. refs.
 (Contract EY-76-C-07-1570)
 (TREE-1182) Avail NTIS HC A03/MF A01

Operating characteristics and economics of several representative space heating systems are analyzed. Analyses are based on the use of geothermal water at temperatures as low as 120 F in forced air systems and 140 F in baseboard convection and radiant floor panel systems. The baseboard convection system is the most economical type of geothermal space heating system when geothermal water of at least 140 F is available. Heat pumps utilizing water near 70 F, with negligible water costs, are economically feasible and they are particularly attractive when space cooling is included in system designs. Procurement and installation costs for similar geothermal and conventional space heating systems are about equal, so geothermal space heating

is cost competitive when the unit cost of geothermal energy is less than or equal to the unit cost of conventional energy. Guides are provided for estimating the unit cost of geothermal energy for cases where a geothermal resource is known to exist. ERA

N78-33568# Department of Energy, Washington, D C
ENVIRONMENTAL DEVELOPMENT PLAN (EDP) SOLAR AGRICULTURAL AND INDUSTRIAL PROCESS HEAT, 1977

Mar 1978. 47 p. refs.
 (DOE/EDP-0002) Avail NTIS HC A03/MF A01

Potential environmental health safety and socioeconomic impacts relevant to solar process heat are described. A management plan is presented for conducting and coordinating environmental research in concert with the technology development effort. Investigations include fluid/waste characterization studies, contamination pathway analyses, ecological effects research, human toxicology studies, and mitigation strategies. ERA

N78-33569# Resource Planning Associates, Inc., Washington, D C
INSTITUTIONAL APPLICATIONS OF SOLAR TOTAL ENERGY SYSTEMS Quarterly Report

31 Jan 1978. 75 p. refs.
 (Contract EG-77-C-04-3768)
 (ALO-3786-2, QR-3) Avail NTIS HC A04/MF A01

Estimates are presented of the availability of land for solar total energy (STE) systems. The investigation of the external decision processes that affect an STE system choice was continued. The STE system/utility interface was examined, presenting regional time-of-day pricing scenarios and estimates of backup rates. The possible effects that the financial community could have on STE market penetration was considered. Regional and sectoral energy use profiles were developed. These profiles served as a basis for simulating yearly system performance on an hourly basis to estimate system costs and savings. Preliminary conceptual designs were developed for both thermal and photovoltaic STE systems. Refined system designs and detailed capital cost and performance estimates for the optimized designs are presented. Author (ERA)

N78-33570# Oak Ridge National Lab., Tenn.
COMMERCIAL DEMAND FOR ENERGY: A DISAGGREGATED APPROACH

Jerry R Jackson, Steve Cohn, Jane Cope, and William S Johnson. Apr 1978. 69 p. refs.
 (Contract W-7405-eng-26)
 (ORNL/CON-15) Avail NTIS HC A04/MF A01

The structure and forecasting accuracy of a disaggregated model of commercial energy use recently developed is described. The model forecasts annual commercial energy use by ten building types, five end uses, and four fuel types. Both economic (utilization rate, fuel choice, capital-energy substitution) and technological factors (equipment efficiency, thermal characteristics of buildings) are explicitly represented in the model. Model parameters were derived from engineering and econometric analysis. The model was then validated by simulating commercial energy use over the 1970-1975 time period. The model performs well both with respect to size of forecast error and ability to predict turning points. The model was then used to evaluate the energy-use implications of national commercial buildings standards based on the ASHRAE 90-75 recommendations. ERA

N78-33571# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif
CENTRAL RECEIVER SOLAR THERMAL POWER SYSTEM. PHASE 1. CDRL ITEM 2. PILOT PLANT PRELIMINARY DESIGN REPORT. VOLUME 2. SYSTEM DESCRIPTION AND SYSTEM ANALYSIS

R W Hallet, Jr and R L Gervais. Oct 1977. 534 p. refs.
 (Contract EY-76-C-03-1108)
 (SAN-1108-8/1-Vol-2, MDC-G-6776-Vol-2) Avail NTIS HC A23/MF A01

An active system analysis and integration effort was conducted. Initial program requirements were transformed into

a preliminary system design Subsystem requirements for subsystem design and test activity were generated The final preliminary design was reviewed to ensure that the subsystems were operationally compatible and capable of producing electricity at the lowest possible cost per unit of energy ERA

N78-33572# Los Alamos Scientific Lab., N Mex
THERMAL DRAWDOWN AND RECOVERY OF SINGLY AND MULTIPLY FRACTURED HOT DRY ROCK RESERVOIRS
R Wunder and H Murphy Apr 1978 18 p refs
(Contract W-7405-eng-36)
(LA-7219-MS) Avail NTIS HC A02/MF A01

A computer code was written to solve the differential equations for rock-water heat conduction and convection by finite differences Temperature versus time functions for multiple fractures separated by various spacings are presented in dimensional and in nondimensional plots The results were specialized for the limiting case of a single fracture in unbounded rock and for the other limiting case where the rock is so extensively fractured that thermal breakthrough phenomena can occur Fracture temperatures were calculated during the thermal recovery following various extraction periods For the single-fracture case these temperature recoveries could with slight approximation, be represented as a single curve depending only upon the ratio of the total elapsed time and the extraction time ERA

N78-33573# Ocean Data Systems, Inc., Monterey, Calif
OTEC THERMAL RESOURCE REPORT FOR HAWAII
Oct 1977 61 p refs
(Contract EG-77-C-01-4028)
(TID-27950) Avail NTIS HC A04/MF A01

Most probable monthly temperature profiles from surface to 1500 meter depths were developed for eight one-degree latitude-longitude squares off Hawaii These ocean areas are characterized by remarkably homogeneous temperature conditions and small variability at all depths In particular, a temperature differential in excess of 20 C exists between the surface layer and the 1000 meter depth and the entire year in several of the areas An inventory summary is included of the temperature observations available in the area, as well as overall bathymetric information The monthly temperature data are provided in tabular form and as plots of temperature differential versus depth for each latitude-longitude square ERA

N78-33574# Kaman Sciences Corp., Colorado Springs, Colo
PHOENIX HOUSE: SOLAR-ASSISTED HEAT PUMP SYSTEM EVALUATION Final Report, Mar. 1978
D M Jardine and D W Jones Mar 1978 73 p refs Sponsored by EPRI
(EPRI-ER-712) Avail NTIS HC A04/MF A01

Solar electric heating systems, their testing, and their electric system interfacing with the city of Colorado Springs municipal utility are examined Thermal load is dynamic and changes characteristics as residential buildings age Performance characteristics of an operational ground-coupled thermal energy storage system linked to fluid-cooled solar collectors and a series liquid-to-air heat pump are analyzed Validated operational temperature boundary heat transfer coefficients for the storage system are developed using seasonal performance data generated at the Phoenix Project The impact on the city utility's electric system is developed for connecting various types of solar and electric-heating systems in various quantities from 1978 through 1984 The main impact statement centers on the average cost per kWh of generating and delivering electric power to all classes of customers when the heating systems are connected in various quantities Heating-system load factors, and their impact on the utility's electric-system load factor are analyzed ERA

N78-33575# Colorado School of Mines, Golden Dept of Engineering Physics
OPEN CYCLE OCEAN THERMAL ENERGY CONVERSION: A PRELIMINARY ENGINEERING EVALUATION
A D Watt, F S Mathews, and R E Hathaway 31 Dec 1977 132 p refs
(Contract EY-76-S-04-3723)

(ALO-3723-76/3) Avail NTIS HC A07/MF A01

The following subjects are covered physical environment, system layout, warm water loop, turbine/generator, cold water loop, system performance and cost and areas of major uncertainty ERA

N78-33576# Burns and McDonnell, Kansas City, Mo
ASSESSMENT OF THE FUEL CELL'S ROLE IN SMALL UTILITIES Final Report
Peter Steitz, G Mayo, D Taylor, and H Lehman Feb 1978 210 p
(EPRI Proj 918)
(EPRI-EM-696-Vol-1) Avail NTIS HC A10/MF A01

Fuel cell characteristics most important to ensuring its success in the small utility market were identified Areas studied were the (1) analysis of small utility characteristics, (2) selection of six reference systems and expansion from 1980 to 2000 with conventional generation, (3) expansion of the six reference systems with five fuel cell types and comparison with conventional expansions, (4) determination of threshold values for key fuel cell characteristics, and (5) quantification of the potential benefits associated with certain of the fuel cell's unique features Results show that the fuel cell has the potential for significant penetration into the small utility market, competing with conventional generation from the base load to the intermediate and peaking ranges of operation, especially if the characteristics specified for the advanced fuel cells can be achieved The major potential limitations on the utilization of fuel cells are oil availability and price ERA

N78-33577# Exxon Research and Engineering Co., Linden, N J
CATALYST SINTERING STUDIES Interim Report
Y C Pan, S C Fung, and G Cipros Mar 1978 155 p refs
Sponsored by DOE
(EPRI-EM-661) Avail NTIS HC A08/MF A01

Methods to retard the loss of catalyst surface area, and therefore, retard the loss of catalytic activity, in phosphoric acid fuel cells are described Phosphoric acid fuel cells use platinum catalysts dispersed as small crystallites on carbon supports. These crystallites are meta-stable and tend to grow to larger size (sinter) with lower surface area due to surface free energy considerations The nature of support substrates, catalyst preparation method addition of adsorbed high valence cations and addition of potentially stabilizing components were studied Platinum sintering rates were significantly different for various support systems A very promising high surface area activated carbon was discovered which showed no measureable loss of platinum surface area after 1002 hours exposure to standard sintering conditions ERA

N78-33578# Cantor (Irwin G.) Office, New York, N Y
INVESTIGATION OF ALTERNATE TYPES OF WATER-STORAGE COMPONENTS TO BE UTILIZED IN CONJUNCTION WITH THE ACES SYSTEM
Dec 1977 78 p refs
(Contract W-7405-eng-26,
(ORNL/Sub-78/14233/1) Avail NTIS HC A05/MF A01

Major areas investigated were cost of the tank, and integration with the construction project Nationwide tank building capability, and average costs are given Costs of free-standing tanks were found to average \$2 00/cu ft for a 500 cu ft tank and \$1 37/cu ft for a 3000 cu ft tank. The least-costly tanks were those which are field constructed and fully integrated with the project design Traditional materials and procedures (masonry and concrete) offer the greatest flexibility and lowest cost Such integration can create cost savings of approximately 50% since load bearing walls can fulfill additional structural (foundation) requirements The least costly method of tank construction available was foam-form block, a proprietary system using reshaped polystyrene open cell blocks between which are placed reinforcing steel and concrete ERA

N78-33579# Department of Energy, Washington, D C
ENVIRONMENTAL DEVELOPMENT PLAN (EDP): ENERGY STORAGE SYSTEMS, FY 1977

Lynne Holt, Richard Jones, and Graham Hagey Mar 1978
145 p refs

(DOE/EDP-0015) Avail NTIS HC A07/MF A01

The physical, biological, social cultural, health and safety environmental concerns associated with energy storage are examined. The requirements and actions needed to resolve these concerns, and a time-phased plan for the evaluation and mitigation of negative environmental impacts are presented. A framework is provided for incorporating environmental considerations into the planning process at the appropriate stage, resolving environmental issues concurrently with the technology development, and assuring that adverse environmental effects are mitigated through sound technological design. ERA

N78-33580# Completion Technology Co., Houston, Tex
GEOTHERMAL WELL COMPLETIONS: AN OVERVIEW OF EXISTING METHODS IN FOUR TYPES OF DEVELOPMENTS

Robert E Snyder Jan 1978 128 p refs
(Contract EY-76-C-04-0789)

(SAND-78-7010) Avail NTIS HC A07/MF A01

Existing practices and capabilities for completing wells for geothermal application in each of four categories of geothermal environments are discussed. Included are steam wells in hard, fractured rocks (The Geysers, California), hot water wells sedimentary formations (Imperial Valley, California), hot, dry impermeable rocks with circulating water systems (Valles Caldera, New Mexico), and geopressed, geothermal water wells with associated hydrocarbon production on the U.S. Gulf Coast. ERA

N78-33581# Bureau of Mines, Washington, D.C.
PROJECTS TO EXPAND FUEL SOURCES IN EASTERN STATES: AN UPDATE OF INFORMATION CIRCULAR 8726. SURVEY OF PLANNED OR PROPOSED COAL MINES, COAL AND NONCOAL CONVERSION PLANTS, ELECTRIC GENERATING PLANTS, OIL REFINERIES, URANIUM ENRICHMENT FACILITIES, AND RELATED INFRASTRUCTURE, IN STATES EAST OF THE MISSISSIPPI RIVER (AS OF JULY 1977)

David C Benson and Frank J Doyle 1978 156 p refs
(BM-IC-8765) Avail NTIS HC A08/MF A01

Tables listing the name, location and other pertinent data concerning certain fuel-related projects are presented. Information on projects involving the proposed or planned development of fuel resources, as well as the development of storage, transportation, and conversion facilities is included. Of the total 535 projects for which information is provided, 429 concern coal mines and electric generating plants. ERA

N78-33582# California Univ., Berkeley Lawrence Berkeley Lab

Cu/SUB x/S-(Cd, Zn)S PHOTOVOLTAIC SOLAR ENERGY CONVERTERS Quarterly Report, Jul. - Sep. 1977

T M Peterson, B L Chin, K Seshan, and J Washburn Nov 1977 26 p refs

(Contract W-7405-eng-48)

(HCP/T7405-1 QR-2) Avail NTIS HC A03/MF A01

Reproducible growth of uncracked, thick films of (Cd,Zn)S was accomplished on the As(antis 111) face of GaAs substrates and on substrates tilted approximately 14 deg off of (antis 111). Modifications to the hot wall deposition apparatus were made to eliminate the trace impurities found at the perimeter of the films. Techniques for transmission electron microscope specimen preparation were developed. Results yielded evidence supporting Ga-face film cracking by an interfacial layer of GaS. The spectral response portion of the device measurement apparatus is operational. The elastic tunneling calculations agree with experimental results for I-V characteristics of illuminated cells. ERA

N78-33583# California Polytechnic State Univ., San Luis Obispo
RESEARCH ON THE APPLICATION OF SOLAR ENERGY TO INDUSTRIAL DRYING OR DEHYDRATION PROCESSES Final Phase Report

Mar 1977 234 p refs

(Contract EY-76-C-05-5123)

(ORO-5123-1) Avail NTIS HC A11/MF A01

The dehydration operation is described. The system design and its economic analysis are discussed. The system analysis covers the solar collectors, fan and ducting selection, rock storage design, heat recovery, control system, system simulation, and the monitoring system. The construction costs are discussed thoroughly. The construction design is presented including drawings. ERA

N78-33584# Brookhaven National Lab., Upton, N.Y. Dept of Energy and Environment

AMORPHOUS SEMICONDUCTORS IN PHOTOVOLTAIC AND SOLAR THERMAL CONVERSION

Richard W Griffith 1978 6 p refs Presented at Intern Solar Energy Congr., New Delhi, 16 Jan 1978

(Contract EY-76-C-02-0016)

(BNL-24216, Conf-780114-7) Avail NTIS HC A02/MF A01

Amorphous semiconductor materials promise to play an important role in solar energy conversion. For photovoltaic applications, acceptable efficiencies η in large-area Schottky cells may be possible if hole transport in a-Si can be improved. Indeed, in very small-area cells (approx 1 sq mm) reasonable upper limits η approximately 6% were reported in the literature. For solar thermal applications, studies on Si/sub 1-x/B sub x/ alloys point toward the realization of solar coatings that are stable at high temperatures and that satisfy the dual requirement of high solar absorptance α /sub s/ and low infrared emittance ϵ . ERA

N78-33585# Argonne National Lab., Ill

DESIGN OF CPC PHOTOVOLTAIC SOLAR COLLECTORS

R M Graven, A J Gorski, and W R McIntire 1978 6 p refs Presented at Intern Solar Energy Congr., New Delhi, 16 Jan 1978

(Contract W-31-109-eng-38)

(CONF-780114-8) Avail NTIS HC A02/MF A01

Two new photovoltaic solar collectors were designed, built and tested. A substantial improvement in performance was achieved in that they produce more electrical power and use significantly less photovoltaic material per unit area than the present state-of-the-art flat panel arrays. A reflective style Compound Parabolic Concentrator (CPC) optical system was used for one collector, and a dielectric style (DCPC) optical system was used for the other collector to concentrate sunlight onto custom designed photovoltaic solar cells. For these two panels only periodic angular adjustments are required which eliminates the need for two-axis tracking. A modular design of individual sub-units containing an array of series and parallel circuits allows a user to select a variety of operating conditions. ERA

N78-33586# Los Alamos Scientific Lab., N. Mex

SOLAR-THERMOCHEMICAL PRODUCTION OF HYDROGEN FROM WATER

K E Cox and M G Bowman 1978 16 p refs Presented at Solar Thermal Test Facilities Users Assoc. Meeting, Golden, Colo., 11 Apr 1978

(Contract W-7405-eng-36)

(LA-UR-78-1052, Conf-780447-2)

Avail NTIS HC A02/MF A01

Large scale hydrogen production using solar energy for the decomposition of water by thermochemical cycles electrolysis, or a hybrid combination of these methods is reviewed. The potential higher efficiency and lower cost for thermochemical methods, versus the overall electrolysis was recognized. The criteria for the selection of an appropriate thermochemical cycle for matching with a high temperature solar heat source are detailed. Advantages of a thermochemical cycle based on a solid sulfate decomposition that makes use of isothermal high temperature energy is detailed, and a plan for the implementation of such a cycle on a central tower solar receiver is given. ERA

N78-33587# Black and Veatch Consulting Engineers, Kansas City, Mo
SOLAR-THERMAL CONVERSION TO ELECTRICITY UTILIZING A CENTRAL RECEIVER, OPEN-CYCLE GAS TURBINE DESIGN Final Report

J C Grosskreutz Mar 1978 226 p refs Sponsored by EPRI (EPRI-ER-652) Avail NTIS HC A11/MF A01

A program to develop a solar/electric power plant which utilizes an open cycle gas turbine as the prime mover is discussed. A conceptual design for a commercial-scale plant, with a nominal rating of 60 MWe, was prepared. The characteristics of the design, which employs an elevated central receiver surrounded by a field of heliostats, are presented. Energy storage, both buffer and long-term is provided by fossil fuels. The fuel, either oil or gas, is burned in combustors which are in a parallel arrangement with the solar receivers. The turbine inlet gas temperature is 982 to 1066 C. Because these temperatures preclude the use of any available metal for the heat transfer surface, ceramics are employed. Experiments verified the suitability of silicon carbide for an application of this type and also verified the analytic methodology which had been used in the receiver design activities. Preliminary estimates of the physical and operating characteristics of a bench model solar receiver employing silicon carbide tubes, were developed. ERA

N78-33589# California Univ Livermore Lawrence Livermore Lab
ANALYSIS OF OFF-GUIDEWAY ENERGY STORAGE/PROPULSION SYSTEMS FOR DUAL MODE TRANSIT SYSTEMS

Ivan J Sacks 9 Mar 1978 25 p refs Presented at the Advanced Transit Assoc Intern Conf Indianapolis, 25-28 Apr 1978

(Contract W-7405-eng-48)

(UCRL-80874, Conf-780426-1)

Avail NTIS

HC A02/MF A01

Some evaluation criteria and a method for combining these criteria for the selection of an energy storage propulsion system for off guideway operation of a dual mode transit system are presented. In addition, technical options for these energy storage propulsion systems are discussed. These options are drawn from mechanical, chemical, and electrical energy storage systems. The selection criteria discussed are used to select attractive near term system option. ERA

N78-33590# Energy Development Associates, Madison Heights, Mich

DEVELOPMENT OF HIGH-EFFICIENCY COST-EFFECTIVE, ZINC-CHLORINE BATTERIES FOR UTILITY PEAK-SHAVING, 1976 Interim Report

Philip C Symons Mar 1978 277 p

(EPRI-EM-711) Avail NTIS HC A13/MF A01

Principle thrusts of this program were battery scaleup by a factor of twenty from earlier work and investigation of the economics of zinc-chlorine peak-shaving batteries located at utility substations. Development programs on cell performance, electrode research, and materials of construction were conducted in support of these objectives. A battery was designed, built, and tested which delivered 18 kWh dc at an electrochemical energy efficiency of 60%. Two smaller systems were built and tested in order to permit informed selection of the chlorine electrode material. Porous graphite was chosen. The cycle-testing of two battery systems are successfully automated. Two conceptual designs were prepared. A detailed cost breakdown was provided for each design. ERA

N78-33591# Little (Arthur D.), Inc. Cambridge, Mass
ENERGY EFFICIENCY AND ELECTRIC MOTORS

Apr 1978 173 p

(HCP/M50217-01) Avail NTIS HC A08/MF A01

The underlying hypothesis of this investigation is that efficiency ratings are not being given proper consideration in the selection and purchase of electric motors. The study is concerned with five tasks: (1) equipment characterization concerned with standard and built-in electric motors applied to commercial and industrial process equipment and including AC single-phase and AC polyphase, (2) market characterization, identifying the basis of motor choice by users, (3) tracing the historic progression of motor efficiencies and projected future trends, (4) technological assessing and economic constraints, (5) developing policy option scenarios. ERA

N78-33592# Gulf Research and Development Co., Pittsburgh, Pa

PASSENGER CAR FUEL ECONOMY IN SHORT TRIP OPERATION Technical Progress Report, 1 May 1977 - 30 Nov 1977

C H Phoebe Nov 1977 25 p refs

(Contract EC-77-C-02-4248)

(COO-4248-1) Avail NTIS HC A02/MF A01

A program is described to provide a base line for studies of short-trip fuel economy that will eventually be needed to evaluate alternative power plants and fuels. Objectives are the evaluation of methods devised to provide fuel utilization, and comparison of conventional gasoline with a special fuel blend aimed at improved short-trip economy. The test design, selection of the fuel blends, driving cycle operating procedure, test equipment, selection of the test vehicles, and data handling methods are outlined. Fuel consumption measurements were made on four vehicles operated on a chassis dynamometer at 0 F and 90 F. ERA

N78-33594# Department of Energy, Washington, D C Div of Solar Technology

FEDERAL WIND ENERGY PROGRAM. PROGRAM SUMMARY

Jan 1978 78 p

(DOE/ET-0023/1) Avail NTIS HC A05/MF A01

The objective of the Federal Wind Energy Program is to accelerate the development of reliable and economically viable wind energy systems and enable the earliest possible commercialization of wind power. To achieve this objective for small and large wind systems requires advancing the technology, developing a sound industrial technology base, and addressing the non-technological issues which could deter the use of wind energy. This summary report outlines the projects being supported by the program through FY 1977 toward the achievement of these goals. It also outlines the program's general organization and specific program elements. ERA

N78-33595# Score Inc. Cambridge, Mass

THE 1976 ENERGY RESOURCE ALTERNATIVES II COMPE-TITION Final Report

R A McGill, M Iannucilli, J Marshal, J H Sununu, J E Eschbach, J Anson, D Wark, and D E Stock Oct 1977 260 p

(Contract EY-76-C-02-2698)

(COO-2698-2) Avail NTIS HC A12/MF A01

Descriptions of all the entries in the competition are presented. Competition rules and judging procedures are described. Entries consisted of team efforts from colleges and universities. The competition called for the student teams to develop means for producing electrical power sufficient to meet the needs of a single family home, using an energy source other than oil or natural gas. The electric power produced had to be economically realistic when compared to present energy sources. ERA

N78-33596# Sandia Labs., Albuquerque N. Mex.
TORQUE RIPPLE IN A VERTICAL AXIS WIND TURBINE
R. C. Reuter, Jr. and M. H. Worstell. Apr. 1978. 45 p. refs.
(Contract EY-76-C-04-0789)
(SAND-78-0577) Avail. NTIS HC A03/MF A01

Torque ripple is a name given to time variations in torque which are propagated through the drive train of wind energy conversion systems. An analytical and experimental investigation of torque ripple in a Darrieus vertical axis wind turbine is presented. An analytical model of the turbine is described and numerical results from a solution to the equations of this model are compared to experimental results obtained from the existing DOE/Sandia 17 meter vertical axis wind turbine. Discussions on the source of torque ripple, theoretical and experimental correlation, and means of suppressing its magnitude are included. ERA

N78-33597# Energy Research and Development Administration, Washington, D. C.

ERDA FACILITIES: A NATIONAL RESOURCE FOR RESOLVING ENERGY PROBLEMS

10 Aug. 1977. 370 p.
(ERDA-77-80) Avail. NTIS HC A16/MF A01

Information about ERDA's management structure, program activities, staffing and funding levels is presented. The capabilities of each ERDA's facilities for responding to the nation's energy priorities are outlined. The text was designed for internal use as a management tool to aid in reorganization decision making and as a source of general information for new DOE employees. ERA

N78-33598# Biomass Energy Inst., Inc. Winnipeg (Manitoba).
BIOMASS ENERGY SUCCESS STORIES. A PORTFOLIO ILLUSTRATING CURRENT ECONOMIC USES OF RENEWABLE BIOMASS ENERGY

Mar. 1978. 57 p.
(Contract EG-77-X-10-0285)
(HCP/T0285-02) Avail. NTIS HC A04/MF A01

Twenty-one illustrations of the use of energy from biomass by the sugar, pulp and paper, manufacturing, and wood products industries and for space heating of residences and institutional buildings are presented. Uses include the combustion of wood wastes and sugarcane residues for production of industrial electric power needs, steam production for bleaching and dyeing operations, heat for industrial drying, and space heating. The six appendices give information on the overall availability of biomass and biomass residues in the U.S. and Canada. ERA

N78-33599# National Technical Information Service, Springfield, Va.

FUEL CONSUMPTION: TRANSPORTATION, VOLUME 1. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1964 - 1976

Audrey S. Hundemann. Jul. 1978. 193 p.
(NTIS/PS-78/0707/6) Avail. NTIS HC \$28.00/MF \$28.00 CSCL 10A

Fuel consumption by automobiles, trucks, buses, and general aviation aircraft is discussed. Topic areas cover the effect of road conditions, traffic conditions, and emission controls on fuel economy, projected growth and problems facing air transportation, energy efficiency of various urban transportation modes, energy use forecasts, and projections of supply and demand in the transportation sector. This updated bibliography contains 187 abstracts. GRA

N78-33600# National Technical Information Service, Springfield, Va.

FUEL CONSUMPTION: TRANSPORTATION, VOLUME 2.

A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1977 - Jun. 1978

Audrey S. Hundemann. Jul. 1978. 115 p. Supersedes NTIS/PS-77/0552
(NTIS/PS-78/0708/4, NTIS/PS-77/0552) Avail. NTIS HC \$28.00/MF \$28.00 CSCL 10A

This updated bibliography contains 109 abstracts, dealing with fuel consumption by automobiles, trucks, buses, and general aviation aircraft. The effect of road conditions, traffic conditions, and emission controls on energy efficiency is covered. Projected growth and problems facing air transportation and energy use forecasts and projections of supply and demand in the transportation sector are included. GRA

N78-33601# National Technical Information Service, Springfield, Va.

FUEL CONSUMPTION: INDUSTRIAL, RESIDENTIAL, AND GENERAL STUDIES. VOLUME 1. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1965 - 1976

Audrey S. Hundemann. Jul. 1978. 166 p.
(NTIS/PS-78/0709/2) Avail. NTIS HC \$28.00/MF \$28.00 CSCL 10A

A bibliography containing 162 abstracts concerning research on fuel supply, demand, shortages and conservation through effective utilization is presented. Energy consumption in the agricultural sector, fuel substitution economic studies and environmental concerns relating to energy consumption are also reviewed. GRA

N78-33602# National Technical Information Service, Springfield, Va.

FUEL CONSUMPTION: INDUSTRIAL, RESIDENTIAL, AND GENERAL STUDIES. VOLUME 2. A BIBLIOGRAPHY WITH ABSTRACTS Progress Report, 1977 - Jun. 1978

Audrey S. Hundemann. Jul. 1978. 136 p. Supersedes NTIS/PS-77/0551 COM-74-11102
(NTIS/PS-78/0710/0, NTIS/PS-77/0551, COM-74-11102) Avail. NTIS HC \$28.00/MF \$28.00 CSCL 10A

A bibliography containing 130 abstracts concerning research on fuel supply, demand, shortages and conservation through effective utilization is presented. Energy consumption in the agricultural sector, fuel substitution economic studies, and environmental concerns relating to energy consumption is reported. Bibliographies on electric power consumption and fuel consumption by transportation are also included. GRA

N78-33603# National Technical Information Service, Springfield, Va.

LITHIUM BATTERIES, VOLUME 2. CITATIONS FROM THE NTIS DATA BASE Progress Report, 1975 - Jul. 1978

Mona F. Smith. Jul. 1978. 246 p. Supersedes NTIS/PS-77/0638, NTIS/PS-76/0543, and NTIS/PS-75/471
(NTIS/PS-78/0660/7, NTIS/PS-77/0638, NTIS/PS-76/0543, NTIS/PS-75/471) Avail. NTIS HC \$28.00/MF \$28.00 CSCL 10C

A bibliography containing 241 abstracts concerning research on design, development, components, testing, corrosion, electrolytes, sealing, and hazards of lithium cells is presented. Batteries studied include lithium organic cells, lithium sulfur cells, lithium-water-air cells, and lithium nickel fluoride cells. Applications cover use in spacecraft, electric vehicles, off peak energy storage, and forklift trucks. GRA

N78-33604# National Technical Information Service, Springfield, Va.

LITHIUM BATTERIES. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - Jul. 1978

Mona F. Smith. Jul. 1978. 187 p. Supersedes NTIS/PS-77/0639 and NTIS/PS-76/0544
(NTIS/PS-78/0661/5, NTIS/PS-77/0639, NTIS/PS-76/0544) Avail. NTIS HC \$28.00/MF \$28.00 CSCL 10C

A bibliography containing 180 abstracts concerning studies on design, development, components, corrosion, and hazards is presented. Lithium batteries with sulfides, chlorine, thionyl chloride,

organic compounds, and water are described Applications cover use of lithium cells in pacemakers, spacecraft, electric vehicles, and off peak energy storage GRA

N78-33606# National Technical Information Service, Springfield, Va

LEAD BATTERIES CITATIONS FROM THE NTIS DATA BASE Progress Report, 1964 - Jul. 1978

Mona F Smith Jul 1978 130 p Supersedes NTIS/PS-77/0633, NTIS/PS-76/0549 and NTIS/PS-75/472 (NTIS/PS-78/0689/6, NTIS/PS-77/0633 NTIS/PS-76/0549, NTIS/PS-75/472) Avail NTIS HC \$28 00/MF \$28 00 CSCI 10C

A bibliography containing 124 abstracts concerning the design, development, components fabrication, chemistry, and testing of lead batteries is presented Specific applications for spacecraft consumer products and electric vehicles are presented Studies on lead recovery from battery scrap were reviewed Several abstracts on lead toxicity in industrial plants are also cited GRA

N78-33607# General Accounting Office, Washington, D C Energy and Minerals Div

THE MULTIPROGRAM LABORATORIES A NATIONAL RESOURCE FOR NONNUCLEAR ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION Report to the Congress

22 May 1978 101 p refs (PB-281265/9 EMD-78-62) Avail NTIS HC A06/MF A01 CSCI 10A

The multiprogram laboratories and their enormous scientific and technical potential for the development of nonnuclear energy technologies are examined The eight laboratories represent a cumulative capital investment of over \$3 billion They have a diversity of scientific and technical resources, manpower, and plant facilities for developing new energy technologies Suggestions for using these laboratories in nonnuclear energy in a manner which would improve their working relationships with other research entities are presented GRA

N78-33608# National Technical Information Service Springfield, Va

HELIOSTAT SYSTEMS DESIGN AND OPERATION. CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - Jun 1978

Audrey S Hundemann Aug 1978 44 p (NTIS/PS-78/0842/1) Avail NTIS HC \$28 00/MF \$28 00 CSCI 10A

The design and use of heliostats in solar central receiver thermal power systems are discussed in abstracts from worldwide literature Topic areas include heliostat systems performance efficiency, and optimization Emphasis of the bibliography is on basic research This bibliography contains 38 abstracts GRA

N78-33610# National Technical Information Service, Springfield, Va

FLAT PLATE SOLAR COLLECTOR DESIGN AND PERFORMANCE CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1970 - Jun 1978

Audrey S Hundemann Aug 1978 150 p (NTIS/PS-78/0841/3) Avail NTIS HC \$28 00/MF \$28 00 CSCI 10A

Citations from worldwide literature on the design thermal performance, and optimization of air- and liquid-type flat plate collectors are covered Topic areas include heat loss and heat transfer, effect of orientation, corrosion protection optical coatings, enhancement of performance through the use of planar reflectors and the effect of honeycomb layers on collector performance Grooved corrugated, or V-trough collectors are studied Abstracts dealing with methods of measuring the performance of flat plate collectors and computer optimization studies are included (This bibliography contains 144 abstracts) GRA

N78-33622# Department of Energy, Washington, D C **ENVIRONMENTAL DEVELOPMENT PLAN FOR BUILDINGS AND COMMUNITY SYSTEMS, 1977**

J Hock, J Duane, G Hagey, and D Moses Mar 1978 193 p refs (DOE/EDP-0020) Avail NTIS HC A09/MF A01

Environmental concerns which include ecological, social/economic, health, safety, and resource impacts associated with the research, development, and demonstration of buildings and community energy systems are identified An environmental research and development strategy for resolving the concerns is presented The process provides a framework for incorporating environmental considerations into agency planning processes at the earliest stages resolving environmental concerns concurrently with energy technology development and assuring that adverse environmental effects are mitigated through sound technological design and are at the same level of importance as technological, economic, and institutional issues in decision making Technology thrusts covered are architectural and engineering systems, consumer products and technology, urban waste technology, and community systems ERA

N78-33625# Los Alamos Scientific Lab N Mex **COMPUTER SIMULATION OF THE VISUAL EFFECTS OF SMOKE PLUMES**

Michael D Williams (John Muir Inst), Mona J Weckung, and Ellen M Leonard 1978 8 p refs Presented at the Soc of Photo-Opt Instrumentation Engr Tech Symp, Washington, D C, 28-31 Mar 1978 (Contract W-7405-eng-36) (LA-UR-78-689, Conf-780324-2) Avail NTIS HC A02/MF A01

A technique was developed to modify a clean before scene as dictated by solutions to the radiation transfer problem in a polluted atmosphere This allows production of computer simulated after scenes, which illustrate the visual effects of pollutants emitted under a variety of circumstances Application of this technique to very large coal-fired power plants suggests that such facilities may impair scenic vistas under some circumstances unless stricter pollution controls and standards are enforced ERA

N78-33626# Department of Energy, Washington, D C Div of Biomedical and Environmental Research

MAP3S: STUDYING THE TRANSPORT, TRANSFORMATION, AND FATE OF ATMOSPHERIC ENERGY-RELATED POLLUTANTS

Michael C MacCracken Oct 1977 71 p refs (DOE/EV-0008/1) Avail NTIS HC A04/MF A01

Numerical models were developed to accurately simulate the the atmospheric transformation of atmospheric energy related pollutants for use in assessing the various strategies for generating power. Programs aimed at gaining a better understanding of the role of fossil fuel combustion in affecting the atmosphere are discussed These discussions include measurements of chemical and meteorological variables that determine the distribution of pollutant species from fossil-fuel electric power production, atmospheric research experiments necessary to understand the mechanisms and related processes that must be included in simulation models, and the capability to simulate the atmospheric behavior pollutant concentrations, and precipitation chemistry, effects of emissions from fossil-fuel power plants that are relevant to human health and welfare ERA

N78-33628# Energy Research and Development Administration, Bartlesville Okla Energy Research Center

EFFECTS OF CATALYTIC REACTORS ON DIESEL EXHAUST COMPOSITION Technical Progress Report

W F Marshall, D E Seizinger and R W Freedman Apr 1978 14 p refs (Contract DI-BM-J-166023) (Pd-281083/6, BM-TPR-105) Avail NTIS HC A02/MF A01 CSCI 07D

Tests conducted with four different catalytic reactor designs to determine the influence of exhaust treatment systems on emissions from diesel engines are discussed. Although there are significant differences in oxidation efficiencies at light to intermediate engine loads, all four catalysts were very effective in reducing emissions at heavy loads. Compositional determinations included carbon monoxide, carbon dioxide, unburned hydrocarbons, oxides of nitrogen, aldehydes, sulfur dioxide, sulfates, and particulate loading. Particulate size, exhaust odor intensity, and the character of the unburned hydrocarbon component were also determined. GRA

N78-33836# Research Triangle Inst., Research Triangle Park, N C

SYMPOSIUM PROCEEDINGS ENVIRONMENTAL ASPECTS OF FUEL CONVERSION TECHNOLOGY, 3 Final Report, Apr. 1977 - Feb. 1978

Franklin A Ayer and Martin F Massoglia Apr 1978 547 p (Contract EPA-68-02-2612) (PB-282429/0, EPA-600/7-78-063) Avail NTIS HC A23/MF A01 CSCL 21D

Environmentally related information on coal conversion technology is reviewed and discussed. Major environmental programs, contaminants in coal, process technology, control technology, process measurements, sampling, analytical information on coal gasification and liquefaction, and product usage are among the areas summarized. Specific topics are program approach, environmental assessment, and control technology development. S B S

N78-33842# National Aeronautics and Space Administration, Washington, D C

OPTICAL CHARACTERISTICS OF THE EARTH'S SURFACE AND ATMOSPHERE FROM THE POINT OF VIEW OF THE REMOTE SENSING OF NATURAL RESOURCES. REVIEW OF THE CONTEMPORARY STATUS OF THE PROBLEM

V I Tarnopolskiy Oct 1978 73 p refs. Transl into ENGLISH of 'Opticheskiye Kharakteristiki Poverkhnosti i Atmosfery Zemli s Tochki Zreniya Distantionnogo Issledovaniya Prirodnikh Resursov', Rept Pr-287 Acad of Sci USSR Inst of Space Res Moscow 1976 73 p. Transl by Kanner (Leo) Associates, Redwood City, Calif

(Contract NASw-3199)

(NASA-TM-75548, Pr-287) Avail NTIS HC A04/MF A01 CSCL 04A

Widely used remote probing methods and especially the multispectral method, for studying the earth from aerospace platforms necessitate the systematization and accumulation of data on the relationships between remote observations and measured parameters and characteristic properties and conditions of phenomena on the earth's surface. Data were presented on the optical characteristics of natural objects which arise during observations of these objects over a wide spectral interval which encompasses solar radiation reflected by the object as well as the object's inherent thermal radiation. The influence of the earth's atmosphere on remote measurements and several problems in simulation and calculation are discussed. B B

N78-33872# Wapora, Inc., Washington, D C
SURVEY OF ENVIRONMENTAL REGULATIONS APPLYING TO GEOTHERMAL EXPLORATION, DEVELOPMENT, AND USE Final Report

Gene V Beeland Feb 1978 257 p refs (Contract EPA-68-03-2371)

(PB-281023/2, EPA 600/7-78-014) Avail NTIS HC A12/MF A01 CSCL 10A

Federal, State, and local environmental laws and regulations that apply to geothermal energy development are summarized. Most attention is given to those regulations which deal with air pollution, water pollution, solid wastes, and impact assessments. Analyses are made of the regulations with respect to resource definition, pollutants currently not controlled, duplicity and overlap in permit and impact assessment requirements, the lack of uniformity of regulations between states, and the probable future approaches to the regulatory problems. GRA

N78-33876# Michigan Univ., Ann Arbor Dept of Atmospheric and Oceanic Science

RAIN SCAVENGING STUDIES Progress Report

A Nelson Dingle Jul 1977 83 p refs

(Contract AT(1171)-1407)

(COO-1407-65 Rept-068670-15-P, PR-13) Avail NTIS HC A05/MF A01

The emission, transport, and deposition of key contaminants from coal burning were studied. A numerical mesoscale dynamic model capable of simulating atmospheric motions and precipitation patterns in the Lake Michigan Basin region was developed. A numerical model of cloud microphysics and rain generation in the presence of reactive substances was also derived. A quantitative evaluation of the chemical transformations, the transport and the removal of atmospheric contaminants is presented. S B S

N78-33879# Weather Wing (5th), Langley AFB, Va
TAILORED CLIMATOLOGY OF SEVERE WEATHER Final Report

Robert P Wright Jun 1978 16 p refs

(AD-A056988, Rept-5WWTN-78-2)

Avail NTIS HC A02/MF A01 CSCL 04/2

This technical note describes the design and use of computer-produced climatologies of severe weather reports within 50 statute miles of a given location. Author (GRA)

N78-33881# National Technical Information Service, Springfield, Va

GEOTHERMAL ENERGY PART 1 EXPLORATION, VOLUME 3 CITATIONS FROM NTIS DATA BASE Progress Report, May 1976 - Jul 1978

Mona F Smith Jul 1978 180 p Supersedes NTIS/PS-77/0561

(NTIS/PS-78/0664/9, NTIS/PS-77/0561) Avail NTIS HC \$28 00/MF \$28 00 CSCL 20A

The bibliography cites Federally-funded research on geophysical methods, such as electrical resistivity, seismology, magnetic anomaly, and electromagnetic measurements in geothermal site survey determination. Studies on well logging, remote sensing, geochemistry, mineralogy, radioactivity, mapping, volcanism, and structural geology are included. Criteria for location of geothermal areas are suggested in these abstracts. (This updated bibliography contains 174 abstracts, 72 of which are new entries to the previous edition.) GRA

N78-33882# National Technical Information Service, Springfield, Va

GEOTHERMAL ENERGY PART 2 CORROSION AND EQUIPMENT, VOLUME 3 CITATIONS FROM THE NTIS DATA BASE Progress Report, May 1976 - Jul 1978

Mona F Smith Jul 1978 94 p Supersedes NTIS/PS-77/0562

(NTIS/PS-78/0665/6, NTIS/PS-77/0562) Avail NTIS HC \$28 00/MF \$28 00 CSCL 20A

Citations of Government-sponsored research reports on corrosion and equipment studies related to geothermal energy are presented. Studies on pumps, turbines, drilling equipment, pipes, nozzles, and well casings are covered, along with studies on materials including concretes, steels, and nonferrous alloys. Silica precipitation and scale formation on equipment are also cited. Performance of equipment in working fluids and brines and the chemical processes affecting performance are included. (This updated bibliography contains 88 abstracts, 42 of which are new entries to the previous edition.) GRA

N78-33883# National Technical Information Service, Springfield, Va

GEOTHERMAL ENERGY PART 3 TECHNOLOGY AND GENERAL STUDIES, VOLUME 3 CITATIONS FROM THE NTIS DATA BASE Progress Report, May 1976 - Jul 1978

Mona F Smith Jul 1978 333 p Supersedes NTIS/PS-77/0563
(NTIS/PS-78/0666/4, NTIS/PS-77/0563) Avail NTIS
HC \$28 00/MF \$28 00 CSCL 20A

This bibliography covers Government-sponsored research on geothermal energy conversion, power plants, heat extraction, space heating, and steam power plants. Studies on fluid flow, heat transfer, rock fracturing, computerized simulation, pressure, and reservoir engineering are included. Reports on economics, legislation, technology assessment, comparative evaluation with other energy sources, Government policies, and planning are also cited. (This updated bibliography contains 326 abstracts, 153 of which are new entries to the previous edition) GRA

N78-33884# National Technical Information Service, Springfield, Va

GEOHERMAL ENERGY, VOLUME 3 CITATIONS FROM THE ENGINEERING INDEX DATA BASE Progress Report, 1976 - Jul. 1978

Mona F Smith Jul 1978 330 p Supersedes NTIS/PS-77/0565, NTIS/PS-78/0465
(NTIS/PS-78/0667/2, NTIS/PS-77/0565, NTIS/PS-78/0465) Avail NTIS HC \$28 00/MF \$28 00 CSCL 20A

Citations from worldwide literature on geothermal energy conversion, feasibility, development, and cost estimates are presented. Studies on geothermal exploration, drilling technology, fluid flow, convection, thermodynamics, heat extraction and electric power plants are covered. Equipment corrosion, reservoir engineering, and remote sensing are included. (This updated bibliography contains 323 abstracts, 150 of which are new entries to the previous edition) GRA

N78-33943# Argonne National Lab., Ill

LOCAL MEASUREMENTS IN TWO-PHASE LIQUID-METAL MHD

G Fabris, P F Dunn, and E S Pierson 1978 9 p refs
Presented at 2d Seminar on MHD Flows and Turbulence, Beer-Sheva, Israel, 28 Mar 1978
(Contract W-31-109-eng-38)
(CONF-780336-2) Avail NTIS HC A02/MF A01

Since the inception of the development of a two-phase liquid-metal magnetohydrodynamic (LMMHD) power generation system at Argonne National Laboratory, increasing emphasis is placed on the relation between the characteristics of local two-phase flow structure and LMMHD generator efficiency. A local-measurements program was undertaken to characterize the local flow structure occurring inside two-phase LMMHD mixers and generators. Continuing local-measurement experiments are in progress at ANL using (single and multiple resistivity probes and (single) hot-film probes to determine local void fractions, velocities and turbulence intensities. The techniques which were tested and proved successful in air-water mixtures are now being extended to NaK-nitrogen mixtures, in which some initial tests were made ERA

N78-33985# Engineering Societies Commission on Energy, Inc., Washington, D C

ESCOE INFORMATION RETRIEVAL SYSTEM. SYSTEM DESCRIPTION AND OPERATION

W J Costley Apr 1978 41 p refs
(Contract EF-77-C-01-2468)

(FE-2468-26) Avail NTIS HC A03/MF A01

The Engineering Societies Commission Energy (ESCOE) Technical Information Retrieval System is described. The technical information needs of the ESCOE resident engineers in providing services to DOE were identified, and the information resources that best match those needs were examined. The assessment of information needs resulted in the selection of an ESCOE information base. The best mix of information sources and services was selected, and a remote terminal was acquired to access those sources that are available as computerized data bases ERA

N78-33996# General Accounting Office, Washington, D C
Energy and Minerals Div

DEPARTMENT OF ENERGY'S CONSOLIDATION OF INFORMATION PROCESSING ACTIVITIES NEEDS MORE ATTENTION

3 May 1978 54 p refs

(PB-281269/1, EMD-78-60) Avail NTIS HC A04/MF A01
CSCL 09B

The House Committee on Government Operations asked GAO to review the Department of Energy's information processing activities. The report presented several recommendations to the Secretary of Energy and to the Congress to improve management of information-related activities funded by the Department GRA

N78-34007# Jet Propulsion Lab., Calif Inst of Tech., Pasadena
EVALUATION OF FIDC SYSTEM Final Report

Robert A Hall, Mack W Dowdy, and Theodore W Price 15 Oct 1978 132 p Prepared for DOE

(Contract NAS7-100)

(NASA-CR-157763, JPL-Pub-78-93) Avail NTIS
HC A07/MF A01 CSCL 21A

A fuel vapor injector/igniter system was evaluated for its effect on automobile engine performance, fuel economy, and exhaust emissions. Improved fuel economy and emissions, found during the single cylinder tests were not realized with a multicylinder engine. Multicylinder engine tests were conducted to compare the system with both a stock and modified stock configuration. A comparison of cylinder-to-cylinder equivalence ratio distribution was also obtained from the multicylinder engine tests. The multicylinder engine was installed in a vehicle was tested on a chassis dynamometer to compare the system with stock and modified stock configurations. The fuel vapor injector/igniter system (FIDC) configuration demonstrated approximately five percent improved fuel economy over the stock configuration, but the modified stock configuration demonstrated approximately twelve percent improved fuel economy. The hydrocarbon emissions were approximately two-hundred-thirty percent higher with the FIDC system than with the stock configuration. Both the FIDC system and the modified stock configuration adversely affected driveability. The FIDC system demonstrated a modest fuel savings, but with the penalty of increased emissions, and loss of driveability A R H

N78-34008# Burns and McDonnell, Kansas City, Mo
ASSESSMENT OF THE ROLE OF ADVANCED TECHNOLOGIES IN SMALL UTILITIES Final Report

P Steitz and G Mayo May 1978 173 p Sponsored by the Electric Power Research Inst

(EPRI-EM-696-Vol-2) Avail NTIS HC A08/MF A01

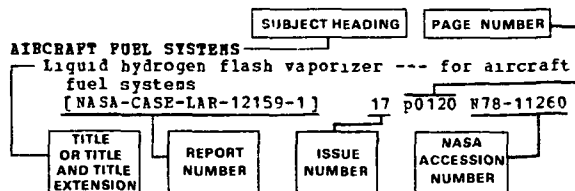
The potential role of six advanced technologies in small municipal and rural electric utility systems was assessed by comparing the economics of utilizing these advanced technologies with the economics of conventional generation types. The technologies examined included a 5-MW coal-fired diesel engine, a 5-MW coal-fired closed cycle combustion turbine, a 2-MW coal-fired Stirling engine, a 2-MW oil-fired Stirling engine, a 1-MW organic Rankine cycle bottoming on a 5-MW diesel and a 1-MW two-phase engine bottoming on a 5-MW diesel engine. If the heat rates projected are achieved, significant market penetration could be realized at capital costs of \$250 to \$300 per kilowatt in 1975 dollars. The coal-fired diesel has the lowest break-even capital cost and, even allowing for the uncertainties of operation and maintenance, costs would be only marginally attractive at a cost above \$500/kW. The coal-fired combustion turbine and the coal-fired Stirling engine could be attractive at costs below \$450/kW and \$650/kW respectively ERA

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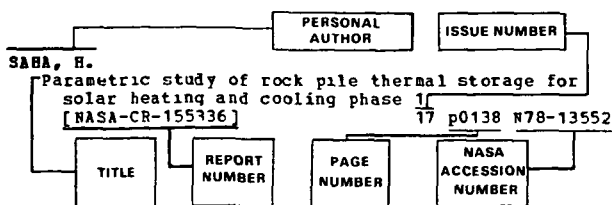
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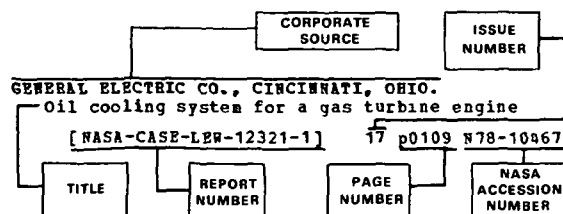
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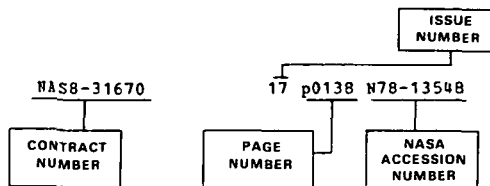
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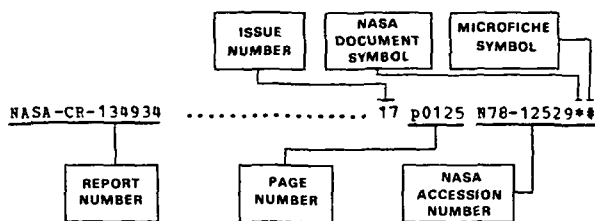
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